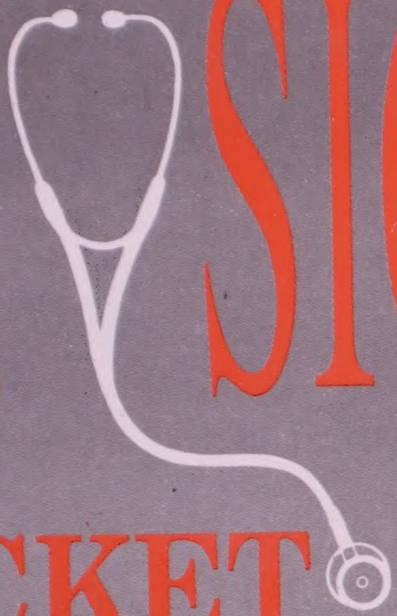
PHYSICIAN'S POCKET MANUAL



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COMMUNITY HEALTH CELL

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To Gita, Usha and our parents

The four stumbling blocks to Truth

* *The influence of fragile or unworthy authority*
* *Custom*
* *The imperfection of undisciplined senses*
* *Concealment of ignorance by ostentation of seeming wisdom*

–Don Tarquinio

PREFACE

Two aspects of medical practice stand out as icons of the profession: ordering laboratory tests and prescribing drugs. They are so much an established part of medical practice that doctors and patients alike feel very reluctant to forego either of them. Doctors view Medicine as a science and like to see themselves as scientists. Scientific medical practice demands that a process of reasoning and justification accompany every medical intervention, diagnostic or therapeutic. No test should be ordered at random, no drug prescribed without good cause.

A good portion of the habits we learn in medical practice are acquired in our formative years, those of housemanship and early postgraduation. It is vital therefore that the roots of scientific medical practice be properly grounded in these important years. The medical curriculum in our country still feels it vital to spend countless hours on didactic lectures aimed at detailed, exhaustive and often tedious discussions of disease states. Very little time (almost none if the truth be told) is spent in educating novices in the profession on the scientific practice of medicine. Many things are done out of mindless routine, reinforced by the fact that someone older and more senior was seen or believed to endorse such practices. Bad habits abound and in time, the practitioner's style resembles a witch doctor rather than a thinking scientist.

This manual was envisaged and designed to educate younger physicians on the rational use of common laboratory tests and medicines. It is not an exhaustive review of the subject; it is more of a bedside ready reckoner, an aid to the house officer or doctor in the wee hours of the day when competent help is not available. Much thought and analysis has gone into it. Differences of opinion are bound to arise since medicine is an inexact science; still, we feel that the statements made will bear up to scrutiny.

The Editors

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I

Laboratory Use

1 COMPLETE BLOOD COUNT

The complete blood count (CBC) and the leucocyte differential count are two of the commonest clinical tests obtained in medical practice. These should not be accepted as routine studies for persons who are sick or for screening those who are well. They should be applied rationally and selectively, in situations where there is a prospect of some benefit to patients.

Test Methods

A complete blood count is usually done with a Coulter counter that measures the hemoglobin level, hematocrit, total RBC & WBC count, mean cellular volume and mean cellular hemoglobin concentration.The test does not include the platelet and reticulocyte counts. The leucocyte differential count is a manual test involving the estimation (on counting 100 cells) of the percentages of mature neutrophils, lymphocytes, monocytes, eosinophils, basophils and other cell types.

A Critique Of The Test

Consensus does not exist about the definition of an abnormal value of hemoglobin. However if the conventional definition of anemia of a value two standard deviations below the mean of the population were to be accepted, 1% of all normal males, 10% of all females, 10 -60% of pregnant women, and 10 - 15% of the elderly will be classified as anemic. Thus the classical definition of anemia probably has little clinical utility.

Unreliability is a critical problem with the leukocyte differential count due to both random variation in small samples and observer error. Variation may be due to physiologic factors like smoking and childbirth that depress certain cell lines. Surgery can increase the neutrophil count by 160-350%. In a study it was found that 30% of the variation was due to the unreliability of the test, 50% due to physiologic variation and only 20% due to disorders associated with neutrophil abnormalities. Due to the variation and unreliability of the test, increases or decreases may not correlate with a meaningful change in the patient's condition.

The advent of automated technology, it is hoped, will reduce, atleast marginally, the variability of the test in the future.

The CBC In Screening

There is no evidence to support the use of the complete blood count for screening for anemia in asypmtomatic members of the general population. The CBC is not an efficient means of detecting serious underlying disorders.

The CBC On Hospital Admission

The CBC is clearly indicated when patients are admitted for major surgery that may involve more than minor blood loss, or if an infection or a hematologic disorder is suspected. However, in patients who are otherwise well and will be undergoing surgical procedures in which bleeding is minimal the test is not necessary. The setting in which the abnormal results are made out can lead to changes in treatment and potentially to changes in the patient's status. A patient with a terminal malignancy dying of cachexia will not benefit from the diagnosis of mild iron deficiency anemia. On the other hand, a patient found to be leucopenic after chemotherapy and placed in isolation till the blood count recovers, may well benefit.

The leucocyte differential count is a valuable test when done on admission to confirm an infectious process, or to detect patients who are at risk of infection due to granulocytopenia caused by a treatment or a disease already identified. Apart from these situations, the test is of limited benefit for new admissions. The test is also not indicated in most patients admitted for elective surgery.

The CBC In Tests For Suspected Abnormalities

A complete blood count should be obtained in any situation in which there are clinical findings suggestive of anemia, abnormal bleeding, or findings suggestive of polycythemia or any other hematologic disorder. In addition, the test is useful in conditions associated with severe anemia, such as chronic renal failure and malignancy. The test will be most useful in these situations if it affects management (by leading to transfusions or modifying the workup). In patients with well established disease with no symptoms and signs of anemia, there is little to be gained from the test.

The leucocyte differential count is most useful in the diagnostic workup of a patient in the following situations:

1. A newly suspected infection or fever (when the CBC is normal).

2. Suspicion of a disorder associated with secondary abnormalities of the cell lines if the results of the test can affect diagnosis or treatment.

3. A suspicion of a primary hematologic disorder or other indication to examine the smear.

The test has limited value within 36 hours of surgery because it is often abnormal in this situation. The test is not generally necessary to confirm the presence of bacterial infection when leucocytosis has been documented. It may be justified in the diagnostic evaluation of a patient with an abnormal leucocyte count, if there is uncertainity about the cause of the abnormality, or if the results may affect diagnosis or management. The test will not exclude sepsis when the suspicion is high, nor confirm it when suspicion is low.

Repeat Tests

Repeat testing is not indicated in patients in whom no abnormality is suspected. It is not reasonable to test patients daily unless clinically important changes in the results are anticipated.

A repeat leukocyte or differential count is warranted in the following situations:

1. Monitoring a patient with infection who is not improving clinically.

2. Patients in whom new symptoms raise a suspicion of infection or a hematologic process.

3. Patients with leukopenia or cytotoxic therapy.

4. Patients with previous abnormalities of leukocytes.

The clinical situtation should determine the frequency of these tests and there are as yet no clear cut guidelines available in the literature.

Applications Of The CBC

- Ambulatory screening general population - not useful.
- Specific subgroups (pregnant women, institutionalised elderly, immigrants from under developed countries) - probably useful.
- Admission to hospital; no abnormalities suspected - rarely useful.
- Abnormality suspected - useful.
- Repeat tests - useful in some patients at appropriate intervals (see text)

Applications Of The Leucocyte Differential Count

- Ambulatory screening - not useful.
- Admission to hospital; no abnormalities suspected - not useful.
- Abnormalities suspected; newly suspected infection or new fever - useful in some patients.
- Suspicion of a primary hematologic disorder - useful (primary means of making diagnosis).
- Leucocytosis or leucopenia - useful in some patients (when cause is unclear).
- Repeat tests - useful in some patients at appropriate intervals (see text).

2 THE ERYTHROCYTE SEDIMENTATION RATE.

An erythrocyte in plasma is subject to several forces. Under the effect of these forces (including gravity & buoyancy) erythrocytes normally settle down slowly. When these cells become aggregated, they sediment rapidly. Erythrocyte aggregation is caused by electrostatic forces. These cells normally have a net negative charge and repel each other. Many plasma proteins are positively charged and neutralize surface charges of erythrocytes, thus reducing the repulsive forces and promoting aggregation (rouleaux formation). Acute phase reactants in plasma facilitate erythrocyte aggregation. C reactive protein in physiologic concentrations has no effect on the ESR

Test Methods

The Westegren method for determining ESR is recommended by the International Committee for Standardization in Hematology. Anticoagulated venous blood is diluted 4:1 with sodium citrate (or edetic acid EDTA in the modified test) and put in a 200 mm glass tube with an internal diameter of 2.5 mm. At the end of one hour the distance from the meniscus to the top of the column of the erythrocytes is recorded as the ESR.

Empirical Formula For Calculating ESR in mm/hr (Miles et al.)

males - (age in years) /2

females - (age in years + 10) /2

Technical Factors Affecting The ESR

Factors that increase the ESR

- Anemia
- Hypercholesterolemia
- Female sex
- Pregnancy
- High room temperature
- Inflammatory disease
- Tilted ESR tube

Technical Factors Affecting The ESR

Factors that decrease the ESR

- Sickle cell disease
- Anisocytosis
- Spherocytosis
- Acanthocytosis
- Polycythemia
- Extreme leukocytosis
- Bile salts
- High doses of adrenal steroids
- Clotting of blood sample
- greater than 2 hour delay in running the test
- Low room temperature
- Hypofibrinogenemia
- Microcytosis
- Congestive heart failure
- Cachexia
- Short ESR tube

Technical Factors Affecting The ESR

Factors that have no effect on the ESR

- Body temperature
- Recent meal
- Aspirin

Upper limit of normal ESR for men and women.

Age less than 50 years

males	15
females	20

Age greater than 50 years

males	20
females	30

Guidelines

1. Diagnosis

a. Disease detection in asymptomatic patients. The ESR seldom makes a contribution to disease detection in asymptomatic patients.

b. Patients with vague, unsubstantiated illness. ESR is not useful in these patients. Unless the ESR is markedly elevated (>50 mm /hour, according to some studies) there are no grounds to suspect the presence of disease in these patients.

c. Cancer. An elevated ESR is quite common in patients with malignancy. However, malignancy is seldom occult when the ESR is elevated. The ESR is often normal in patients with cancer. Therefore it is not a good test to exclude

occult malignancy in patients with vague symptoms. The ESR can be useful in patients with known cancer. When the ESR is greater than 100 mm/hour, metastases are usually present. *A normal ESR does not exclude metastases.*

d. Temporal arteritis. A normal ESR rules out this disease.

e. Inflammatory arthritis. The value of ESR as an independent diagnostic predictor of these diseases remains to be established.

f. Suspected infection. ESR may be normal in the first several days after the onset of an infection and returns to normal more slowly than the leukocyte count or the body temperature. Thus leukocytosis and fever are better indicators of an acute infection than is an increased ESR. *A normal ESR does not exclude pulmonary tuberculosis*

2. An Extreme Or Unexplained Increase In ESR

a. Very high rate. Most patients with an ESR that exceeds 100 mm/hour have infection, connective tissue disease or malignancy.

b. An unexplained increase. Most asymptomatic patients with an unexplained increase in the ESR will not have any serious disease. The initial step in evaluating such patients is to repeat the test after a short interval.

A low ESR has little clinical significance.

3. Monitoring Disease Activity

The ESR, in correlation with clinical exam, (never alone or as the sole parameter) is useful in monitoring disease activity and prognosis in temporal arteritis, polymyalgia rheumatica, rheumatoid arthritis, and treated Hodgkin's disease.

Recommendations For The Diagnostic Use Of The Erythrocyte Sedimentation Rate.

- The ESR should not be used to screen asymptomatic persons for disease.
- The ESR should be used selectively and interpreted with caution when the history and physical examination fail to provide for a specific diagnosis in a symptomatic person.
- If there is no immediate explanation for an increased ESR, the physician should repeat the test in a few months rather than search for occult disease.
- The ESR is indicated for the diagnosis and monitoring of temporal arteritis and polymyalgia rheumatica.

3 TESTS OF GLYCEMIA IN DIABETES MELLITUS

Urine Glucose Testing

Assays of urine glucose are at their best, an indirect and potentially misleading measure of blood glucose. The reasons for this poor correlation include

1. The renal threshold for glucose monitoring in the non pregnant adult generally begins at 160 - 180 mg/dl (8.88 - 9.99 mmol/L) preventing assessment of lower blood glucose levels.

2. The renal threshold varies among different patients and also for the same patient over time.

3. The urine glucose concentration is necessarily an average value over the period the urine accumulates in the bladder. Autonomic dysfunction in diabetes leads to bladder hypotonia and leads to a persistent admixture of recently formed and stagnant urine.

Fasting And Random Plasma Glucose

The oral glucose tolerance test is the current gold standard for diagnosing diabetes. However it is inconvenient to both the patient and the laboratory and is unnecessary in many cases. Current standards accept a random plasma glucose of greater than or equal to 200 mg /dl (random = 2h after a meal)or a fasting plasma glucose of greater than or equal to 140 as sufficient evidence for diabetes . The specificity of such a positive result is 100%;

Test Methods

Preparation for the test is important.

The amount of glucose administered is 75 g in adults and 1.75 g/kg in children.The test should be performed after a fast of 10 -16 hours. Blood samples should be drawn during fasting and at 30 minutes, one and two hours in the non pregnant adult. In the pregnant patient a 3 hour value is drawn as well *after a 100 g glucose load.*

Subjects must not be chronically malnourished and should have ingested at least 150 g of carbohydrate on a daily basis for the preceding 3 days. They should be ambulatory (bed rest impairs glucose tolerance). During the test they should sit quietly. No caffeine or nicotine should be permitted before or during the test. The test should not be done during an acute medical or surgical illness. The patient should not be on any medication known to affect glucose tolerance. (see table)

As a single glucose tolerance never accurately reflects glucose homeostasis, the test should be performed at least on two occasions before the results are considered definitively abnormal, unless the result is grossly abnormal on the first occasion. (Mayo Clin .proc. 63: 263 -269 1988).

A Critique Of The Oral Glucose Tolerance Test.

1. The test is inconvenient to perform.

2. The test is not reproducible . This is probably its greatest deficiency.

3. Multiple factors affect the test.

Only 1-5% of all patients with impaired glucose tolerance test will become diabetic each year. Up to 50 % of these patients will have a normal glucose tolerance test when retested.

The only advantage of the GTT is to diagnose impaired glucose tolerance. As impaired glucose tolerance is not treated with drugs it is currently recommended that only a fasting blood sugar be used to diagnose.diabetes and the oral glucose tolerance test be withdrawn as a diagnostic test.

Criteria For Interpretation Of The Glucose Tolerance Test

Adult Diabetes mellitus

- Glucose load 75 g
- Fasting value greater than 140 mg/dl

This test is superfluous if fasting value is greater than 140 mg/dl

- 2 hour plasma glucose value greater than 200 mg /dl and 0.5, 1- or 1.5- hour value greater than 200 mg/dl

Adult impaired glucose tolerance.

- Glucose load 75 g fasting value less than 140mg/dl mg/dl , 2 hour plasma glucose value 140- 200 mg /dl and 0.5 , 1- or 1.5 hour value greater than 200 mg /dl

Adult normal

- Glucose load 75g
- Fasting value less than 140mg/dl , 2 hour plasma glucose value less than140 mg /dl and 0.5-, 1- and 1.5 hour values less than 200 mg /dl

Childhood diabetes mellitus

- Glucose load 1.75 g/kg up to 75 g
- Fasting value greater than 140 mg/dl , 2 hour value greater than 200 mg/dl and 0.5-,1- or 1.5 hour value greater than 200 mg/dl

Childhood normal

- Glucose load 1.75 g/kg up to 75 g
- Fasting plasma glucose value less than 130 mg/dl and 2 hour value less than 140 mg /dl

Gestational diabetes

- Glucose load 100 g
- Two or more of the following:
  Fasting plasma glucose value greater than 105 mg /dl; 1 hour value >190 mg /dl; 2 hour value >165 mg /dl; 3 hour value >145 mg/dl.

Clinical Conditions Leading To An Abnormal Glucose Tolerance Test

- Diabetes mellitus
- Improper feeding before the test
- Malnutrition
- Obesity
- Infection and /or fever
- Bed rest
- Endocrine abnormalities*
- Renal disease
- Intracranial tumors
- Neoplastic disease
- Medications (see table)
- Non hereditary conditions of the pancreas
- Hemochromatosis
- Pancreatitis
- Carcinoma of the pancreas
- Pancreatic trauma
- Post gastrectomy syndrome
- Islet cell tumors
- Lipid disorders including lipoatrophic diabetes
- Burns and surgery

** Hypothyroidism and hyperthyroidism, pituitary disorders,acromegaly,adrenal corticalhyperfunction,pheochromocytoma*

Medications Affecting Glucose Tolerance

Diuretics and hypotensives

- Chlorthalidone, clonidine, diazoxide, frusemide, thiazides

Hormones and similar agents

- Corticotrophin, dextrothyroxine, glucagon, glucocorticoids, oral-contraceptives, somatotrophin, thyroid hormones,

Psychoactive agents.

- Haloperidol, lithium carbonate, chlorprothexine, phenothiazines, tricyclic antidepressants.

Neurologically active agents

- Epinephrine, isoproterenol, levodopa, norepinephrine, phenytoin.

Analgesic, antipyretic and other anti-inflammatory agents.

Antineoplastic agents

- Alloxan, L-asparaginase, streptozotocin.

Miscellaneous

- Isoniazid, nicotinic acid.

Glycated Hemoglobin

Minor hemoglobin fractions representing glycation products are higher in-diabetics than in nondiabetics and provide an index of chronic glucose levels.The nonenzymatic attachment of glucose to proteins in the RBC is irreversible, dependent on plasma glucose concentration and persists for the life span of the RBC. These glycated products provide an average of antecedent blood glucose levels. Clinical studies have shown remarkable correlation between the concentration of glycated hemoglobin and the mean level of blood glucose over the preceding 1-3 months. Glycated hemoglobin may be measured chromotographically as Hb A1C/ Hb A1 or colorimetrically as total glycated hemoglobin.

Glycated hemoglobin- Advantages

- Values greater than 3 standard deviations highly (99%) specific for diabetes.
- Very good negative predictive value.
- Single sample ; no patient preparation
- Values are not affected by recent food intake
- Gives information regarding control for the past 8-12 weeks
- Objective test; no "cheating" with results

Glycated hemoglobin is at present the single most accurate assay of chronic glucose control. While this is most useful, it cannot be used as the basis of-detailed adjustments of insulin. Given the relatively slow change in glycated-hemoglobin with changes in plasma glucose, no more than six glycated hemoglobins need to be done each year.

In type I patients glycated hemoglobin early in pregnancy has been reported tobe a risk indicator for congenital malformations (AMJOG 1987 156 : 1096 -100). *It is recommended that a glycated hemoglobin be done every six weeks in the pregnant type I patient.*

Glycated hemoglobin- Disadvantages

- A shortened red cell survival will cause a lowering of values
- Hemoglobinopathies may affect the method used for analysis and will give erroneous results.
- Prolonged periods of hypoglycemia which may go unnoticed by the patient as may occur at night will cause a lowering of value.
- Expense (about Rs.70)

How To Read Blood Glucose Values

Check with your technician if the value is a corrected value. If NOT corrections have to be made for: 1. the method used, 2. the type of sample, 3. the age of the patient if it is a post glucose value and 4. the hematocrit of the samples.

- When a non enzymatic method (Folin Wu method which measures all reducing substances in blood) is used, subtract 20mg for each 100 mL to convert the value obtained to true glucose values. Autoanalysers using sugar filtrates approximate values obtained by enzymatic methods.
- 30mg/100mL should be deducted to convert the value from post glucose levels. Blood glucose values determined from plasma or sera will be 15% higher than those determined from whole blood.
- For patients over 50 add 10mg /100mL for each decade to the post oral glucose values (The National Diabetic Data Group has since withdrawn this recommendation).
- A 10% variation in the hematocrit will result in a blood sugar change of 3.6 mg/100mL in the opposite direction.

4 TESTING GLUCOSE HOMEOSTASIS

Recommendations For Testing In The Diabetic On Treatment.

Note:

1. Intensive therapy in type I diabetes includes the pregnant patient who was diabetic before pregnancy

2. Type I sub groups a) minimal - on single dose insulin b) average - on split or mixed dose insulin c) intensive - multiple or continous insulin

Test Method	Type	Status Of Test	Guidelines
Urine			
Glucose	Type I	not recommended	
	Type II	may be useful in the diet-treated when coupled with periodic timed blood glucose levels.	too insensitive if therapy has potential for hypoglycemia
	Gestational	not recommended	too insensitive for adequate control
Ketones	Type I	only method to detect impending ketosis - acidosis	indicated on sick days and during periods of persistent elevation of plasma glucose >300mg/dl.and150mg/dl in the pregnant diabetic.
	Type II	as above	generally ketosis resistant on sick days only

Test Method	Type	Status Of Test	Guidelines
Ketones	Gestational	as above	Ketosis increased in pregancy. Test first morning glucose and when glucose is greater than 150 mg/dl.
Blood			
Self monitoring of blood glucose (SMBG)	**Type I**		
	Minimal	primary modality allows detection & prevention of hypoglycemia	one test every day plus extra tests on sick days to prevent hypoglycemia.
	Average	as above	two tests (prebreak fast and predinner) per day can aid adjustment of split mixed insulin
	Intensive	mandatory	minimum of 4 daily tests + weekly tests between 2 and 4 a.m. to recognize unidentified nocturnal hypoglycemia.
	Type II	probably useful in insulin and sulfonyl urea treated patients	Adopt same regime as average type I patient.
	Gestational		
	On Insulin	necessary	as in average type I
	Not on insulin	no recommendations available	in absence of risk of hypoglycemia no demonstrable benefit.

Test Method	Type	Status Of Test	Guidelines
Physician measured (occasional) samples)	**Type I**	limited value maybe useful in non compliant patients & in confirming accuracy of SMBG	wide fluctuations in plasma glucose level make sporadic intermittent measurements poor predictors of chronic plasma values; do not provide adequate information about 24 hour glucose profile.
	Type II	primary method in many patients . Check accuracy of SMBG of patients on insulin.	stable blood glucose typical for type II makes intermittent timed samples useful for stable asymptomatic patients fasting blood glucose is an accurate index of glycemia; testing every three months may facilitate near normo glycemia.
	Gestational		
	On Insulin	as in type I	
	Non insulin treated	primary method	frequent fasting and 2 hour post meal tests during antenatal vists facilitate satisfactory control in most patients.

Test Method	Type	Status Of Test	Guidelines
Glycated hemoglobin	**Type I**		
	Minimal & average	complementary. provides index of mean glucose levels of preceding 6-8 weeks	about 3 -4 times a year.
	Intensive	as above	every two months to check SMBG
	Type II	as in minimal type I	for stable patients twice a year.
	Gestational	as above	insensitive to minor degrees of glucose intolerance and may not add significant information to frequent plasma glucose levels.

5 BLOOD UREA NITROGEN & SERUM CREATININE

Blood urea nitrogen and serum creatinine, along with plasma glucose, are among the most common tests ordered on hospital admission. This chapter attempts to evaluate these two tests with reference to their usefulness in clinical practice.

When the glomerular filtration rate (GFR) is constant, serum creatinine varies little from hour to hour and day to day. Creatinine is released from muscle at a fairly constant rate and is excreted unchanged in urine, so very few clinical disturbances not accompanied by changing kidney function, affect its concentration.

Blood urea nitrogen (BUN) on the other hand is affected by other factors other than a change in the GFR, including the nitrogen load and the rate of urine flow. An increase in protein intake or breakdown increases the nitrogen load and thus the BUN. The excretion of urea is closely associated with the excretion of water. High urine flow rates are accompanied by low rates of urea reabsorption and low rates of BUN. The converse also holds true. Thus, besides reflecting the GFR, the BUN is also a measure of the rate of urine flow (thus the hydration) and the nitrogen load (thus the catabolism).

Normal ranges

BUN - 10-18mg/dl

Serum creatinine - 0.6-1.2 mg/dl

Men generally have higher values of serum creatinine than women, due to a larger muscle mass. Most of the test methods(except the as yet unavailable, and cumbersome enzymatic methods) give falsely elevated values in the presence of ketone bodies or cephalosporins, especially cefoxitin.

Use In Estimating Glomerular Filtration Rate

As a screening test for kidney function serum creatinine is preferred to BUN as it is more closely correlated with GFR. In fact creatinine clearance can be predicted reasonably accurately from the serum creatinine concentration by using the formula

creatinine clearance = [(140-age) x weight]/(72 x S. creatinine) where weight is in kilograms and creatinine in milligrams/dL.

Serum creatinine is not a highly sensitive index of early renal insufficiency, since a clinically important fall in creatinine clearance can occur before any rise of serum creatinine.

In patients with normal to moderately decreased values of GFR, the serum non creatinine chromogen level measured by the Jaffe method is approximately balanced by the small tubular secretion of creatinine. These two cancel each other making serum creatinine a reasonable estimate of GFR.

In low levels of GFR, the secretory component becomes proportionately increased leading to as much as a 50% overestimation of GFR by creatinine clearance (as occuring in nephrotic syndrome).

Drugs like cimetidine and cotrimoxazole inhibit tubular secretion of creatinine and may lead to an elevated serum creatinine concentration in the absence of a decrease in GFR.

The sensitivity of serum creatinine and BUN is very low in patients with mild to moderate decreases in GFR; however in very low values of GFR its sensitivity approaches 100%. The specificity is however very high.

Guidelines for Use

Despite the low sensitivity of the serum creatinine test, it is recommended in screening for renal insufficiency in most ambulatory patients, because antihypertensive treatment and perhaps dietary protein or phosphorus restriction appear, to be effective in slowing progression of established renal disease.

Creatinine clearance measurement is not recommended for screening unselected populations. However when a high normal or elevated value of serum creatinine is detected, the creatinine clearance should be measured to determine the need for further diagnostic studies or therapy. Other clinical and laboratory findings (hypertension, long standing diabetes mellitus, proteinuria) are complementary information that should trigger the measurement of serum creatinine levels or creatinine clearance.

Serum creatinine concentration can be used to assess changes in kidney function from day to day (acute renal failure, suspected transplant rejection, or on aminoglycoside therapy) or longer periods (gradually progressive renal damage over several years).

BUN is always measured simultaneously with serum creatinine. The ratio is approximately 10. Values higher than 10 occur when the nitrogen load is high or when urine flow is low.

Recommendations for the use of BUN and serum creatinine in Clinical practice

- As a screening procedure for renal dysfunction serum creatinine is preferred to BUN.
- Screening in an unselected population has no known benefits to recommend it.
- Serum creatinine should be measured everyday in patients with acute renal compromise.
- BUN should never be measured alone. It is of value only when a seurm creatinine level is obtained along with it.
- In hypertensives, a baseline serum creatinine should be obtained.
- Indications for out patient management include - hypertension- every year; chronic renal disease - thrice a year.
- Indications for inpatient management include - aminoglycoside therapy - thrice a week; oliguria - every day; frequent measurements are indicated in all acutely ill patients.

In advanced renal insufficiency, the serum creatinine value is likely to be a reasonably accurate guide to the severity of renal damage, whereas the BUN is likely to be a more accurate reflector of the patient's risk for uremic symptoms. Disproportionately low BUN levels imply that the nitrogen load has been reduced successfully and the risk of uremic symptoms has been reduced.

Simultaneous measurements of BUN and serum creatinine concentrations may be useful in supporting a diagnosis of water intoxication or SIADH. In these conditions the values of both tend to be low.

6 TESTS FOR SYPHILIS

Diagnostic Tests for Syphilis

Syphilis may be diagnosed by identification of Treponema pallidum in specimens taken from the lesions of primary, secondary or congenital syphilis, or indirectly by the detection of antibodies in the blood or cerebrospinal fluid.

Identifying the organism

Dark field microscopy: Exudate from the suspected lesion is collected on a glass slide, covered and examined under a compound microscope equipped with a dark field condenser. T pallidum are corkscrew shaped organisms with regular, deep spirals and exhibit a characteristic motility.

Three independent examinations on sucessive days should be done before pronouncing a specimen negative for syphilis. It is highly sensitive and specific in primary syphilis. Though false negative reactions may occur due to excessive debris, erythrocytes and recent antibiotic administration.

Direct fluorescent antibody Treponema pallidum test: The specimen is collected in a capillary tube or a glass slide and fixed with acetone. Flourescein labeled anti-T pallidum globulin is incubated with the exudate, and the stained smear is examined by flourescence microscopy.

This test should not be done in areas (for example the mouth) that normally harbor saprophytic treponemes.

Serologic tests

1. **Treponemal tests:** These detect antibodies against T pallidum or its components. These include flourescent treponemal antibody absorption test [FTA-ABS] and the microhemagglutination test [MHA-TP]).

2. **Non treponemal tests:** These detect antibodies directed against lipoidal antigens which includes Venereal Disease Research Laboratory [VDRL] test.

VDRL: Purified cardiolipin-lecithin-cholesterol antigen is mixed with serially diluted heated serum on a glass slide that is rotated mechanically at a rate of 180 rotations/min for 4 minutes. Flocculation is read microscopically; medium and large clumps (reactive), no clumps (nonreactive) or small clumps (weakly reactive). This test can be done with CSF which is used without heating. The dilution of serum is done in the powers of two like 2, 4, 8, 16 and so on. Results are recorded as the greatest serum dilution that produces a reactive result.

This test becomes reactive one to three weeks after the appearance of the chancre; the titre rapidly rises and remains at a peak during the first year of infection and falls to lower levels in late syphilis. Fall of titre after treatment is related to the duration of infection before intiation of treatment (1-2yrs).

CSF VDRL is a highly specific indicator for neurosyphilis but its sensitivity is very poor.

Biological false positive reactions have been reported in leprosy, drug addiction, aging, infectious mononucleosis, malaria, relapsing fever, hepatitis, tropical easinophilia and collagen diseases such as SLE and rheumatoid arthritis but this has reduced following purified cardiolipin - lecithin - cholesterol antigen.

FTA-ABS: Heated serum is mixed with sorbent (to remove low grade non-specific antibody) and incubated in slides containing T pallidum antigens. Flourescein labeled antihuman globulin is applied to the slides, which are then examined by flourescence microscopy.

False positive results have been reported in various conditions like autoimmune or connective tissue diseases, genital herpes and narcotic addiction

Hemagglutination: Sensitized sheep erythrocytes (coated with lyzed T pallidum) agglutinate in the presence of antitreponemal antibody in test serum. Failure to agglutinate allows the erythrocyte to settle as a smooth ring or as a button of cells at the bottom of the test tube; this indicates negativity. Agglutination produces a uniformly thin, granular deposit indicating positivity.

The FTA-ABS and MHA-TP tests become reactive in primary syphilis and remain reactive for the patient's lifetime regardless of treatment. The FTA-ABS is the first serologic test to be positive, followed by the MHA-TP and the VDRL later.

Diagnostic Tests In Specific Clinical Situations

Primary syphilis

Positive results are positive dark field, or positive VDRL following a negative dark field. If a negative VDRL follows a negative dark field, repeat dark field and VDRL. A VDRL test in 1 week will provide prompt evidence of infection if the result is positive, a negative result 1 month later makes the diagnosis of syphilis highly unlikely and a negative test 3 months later virtually excludes syphilis.

Secondary syphilis

An initial titre of less than 1:8 should warrant a repeat of VDRL one week and one month later. A rising titre confirms the diagnosis of secondary syphilis, whereas a stable titre of less than 1:8 over the 1 month period virtually excludes the disease. In patients with a stable, low titer, results of an MHA-TP test will distinguish a false positive VDRL test from adequately treated syphilis or latent syphilis.

Screening in asymptomatic persons

Pregnancy: In areas of high prevalance screening is warranted in both early and in late pregnancy. If the diagnosis is in doubt treatment in pregnancy is advocated. If syphilis is adequately treated before the sixteenth week, infection in the fetus can be prevented.

Congenital syphilis.: In mothers treated completely for syphilis, VDRL titers monthly for 3 months is satisfactory. If in doubt treat the child, rather than waiting for the development of signs and symptoms that will confirm the diagnosis. *Screening in asymptomatic infants is not recommended.*

Screening on hospital admission. *Not recommended.*

CSF assessment

CSF examination should be restricted to four situations;

1. In patients with syphilis with neurologic abnormalities.

2. Before retreatment of patients who have had relapses after any form of treatment.

3. As a baseline measure in all patients with syphilis for whom nonpenicillin regimens are prescribed.

4. In all infants suspected of having congenital syphilis.

Note: If cell count is normal, further CSF testing is not required after uneventful treatment for latent syphilis.

Re-treatment should be considered for patients with persistent elevated cell counts at 6 months.

Adequacy Of Treatment For Early And Late Syphilis

VDRL titer 3,6,12 months after treatment	Re-treat if high titer has not fallen by 12 months, or if titer has increased after initial fall
Seropositive persons[$]- CSF-VDRL and CSF count	Treat for neurosyphilis if cell CSF VDRL is positive and cell count is elevated

Follow-up After Treatment For Asymptomatic Neurosyphilis

CSF-cell count 6wks, 3 & 6 months after treatment	CSF cell count at 12 & 24 months if normal at 6 months
Suspected syphilis[@]- treat as for early syphilis	VDRL titer 1,3 &6 months after treatment

** VDRL -Veneral disease research laboratory test; MHA-TP - micro hemagglutination Treponema pallidum test; CSF- cerebrospinal fluid*

 # Includes all pregnant women; proven contacts of persons with infectious disease and persons in demonstrated high risk groups

$ Includes persons with neurologic abnormalities; persons before treatment with non-penicillin regimens and persons before retreatment after treatment failure;

@ - includes womenwith newly discovered syphilis seropositivity late in pregnancy, infants of mothers with inadequately treated syphilis and proven contacts of persons with infectious syphilis.

Recommendations For The Use Of Diagnostic Tests For Syphilis

Immediate diagnostic or therapeutic action	Further investigation or action
Primary syphilis- dark field or direct flourescent test	VDRL titer for follow up
Secondary syphilis- VDRL titer (dark field for immediate result)	VDRL titer for follow up
Selected asymptomatic persons- VDRL	MHA-TP if VDRL is positive

7 TESTS OF LIVER FUNCTION

The liver is the seat of major metabolic processes in the human body. Any injury to these processes is likely to alter liver function. Conversely injury to the liver will reflect on other metablic processes and organ systems. Thus there is no single diagnostic tool available which accurately reflects hepatic function or dysfunction. Moreover, unlike tests employed in clinical evaluation of other organ systems, liver function tests are for the most part highly empirical and often do not indicate either the integrity of liver function or the severity of the disease process. A recognition of these limitations is the most important step in our approach to liver dysfunction.

Tests For Bile Pigments

Clinically icterus is recognized when the serum bilirubin exceeds 2 - 2.5 mg/dL. The most widely employed test for bile pigments is the *van den Bergh* reaction.

The direct van den Bergh reaction should be read at one minute; if the reaction is allowed to proceed longer, a small amount of unconjugated pigment may begin to react in the aqueous medium and false low values for the indirect reacting pigment may be obtained. It would be worthwhile to remember that the van den Bergh reaction represents approximations and not absolute measurements of the direct and indirect bilirubin levels. High Performance Liquid Cromotography (HPLC) removes these errors, at an enhanced cost and is largely unavailable.

Transaminases

Transaminases catalyse the transfer of amino group form aspartate or alanine to alpha ketoglutarate. Alanine amino transferase (ALT; SGPT) is found primarily in the cytosol and is more specific for the liver. Aspartate amino transferase (AST; SGOT) is found in both the cytosol and the mitochondria; its distribution is protean and includes the heart, skeletal muscle, brain, liver, and kidney.

Since the clearance mechanisms of these enzymes are not understood as yet, the interpretation of serum transaminase activity (and their elevations) is necessarily empirical. Although the height of transaminase activity is assumed to reflect the severity of of hepatic necrosis, there are some important exceptions to this (rather fallacious) rule. In even the most severe form of alcoholic hepatitis, levels seldom exceed 200 - 300 IU/L. In contrast, serum transaminase levels of 1000 IU or more may be present in mild uncomplicated viral hepatitis or sudden high grade biliary obstruction. Conversely, initially elevated transaminase activity may fall as the clinical course of a massive hepatic necrosis deteriorates, suggesting that the liver is so severely damaged that, little enzyme activity remains. It would be useful therefore to remember that *levels of transaminases correlate poorly with the severity of liver injury or prognosis* and serial determinations are necessary in the management of a patient will liver dysfunction.

Despite these caveats, serum transaminase activity may be helpful in certain circumstances:

1. They are useful as screening procedures for liver disease. Although AST levels are increased in diseases of other organs, values greater than ten times the upper limit of normal range usually reflect hepatic or or biliary pathology. Moreover the ALT is relatively specific for liver disease. *Screening for liver disease in the general population has a poor diagnostic yeild and is not recommended.* A liver function test should be ordered only if there is a clinical suspicion of liver dysfunction.

2. It is distinctly uncommon for the AST to exceed 15 times the upper limit of normal, except when it occurs suddenly (as in the passage of a stone) or is associated with cholangitis.

3. In contrast with most other forms of parenchymal disease in which the ALT activity usually exceeds or equals AST, in alcoholic hepatitis this relationship is reversed and may be useful diagnostically.

4. Transaminase values are often useful in monitoring the course of acute or chronic parenchymal disease of the liver, although, as noted, they are potentially misleading in certain circumstances.

Alkaline Phosphotase

Alkaline phosphotase (SAP) catalyse the release of inorganic phosphate from the phosphate ester substrate at an alkaline pH. Their biological function is unknown, except for an apparent relationship to bone depositition.

This group of enzymes is present in the liver, bone, bile ducts, intestines, kidneys and the placenta. Hepatic alkaline phosphotase is itself heterogenous. Normally serum alkaline phosphotase activity reflects mainly the liver and bone isoenzymes. In some persons in especially those of blood types O or A who are secretors of the ABO antigens and are positive for the Lewis antigen, intestinal alkaline phosphotase may account for 20 - 60% of the total serum activity. Less common sources include certain tumors of the liver and the lung. Some normal persons also have an elevated alkaline phosphotase level.

Since any disorder of the organ systems producing this enzyme can cause an elevation of SAP, other clinical and laboratory correlates should be used to identify the existence of hepatobiliary disease before interpreting an elevated SAP. Most useful is the measurement of 5' nucleotidase, leucine aminopeptidase and gamma glutamyl transpepeptidase activity which tend to parallel that of SAP in hepatobiliary disease but not in bone disacase. (the first two may be increased in pregnancy)

SAP levels are most useful in the diagnosis of an obstructive biliary duct pathology. Although elevations SAP of are found in all forms of liver disease, a level greater than 3-10 times normal is highly suggestive of an obstruction to the secretion of bile. Most important is the negative predictive value of this test. *A normal SAP virtually excludes obstruction*. Conversely, an elevated SAP may be the only abnormal finding in bile duct strictures or in lesions that produce obstruction of a single hepatic lobe or segment. As, many as one third of patients with isolated elevations in levels of SAP may have no demonstrable underlying liver or biliary disease.

Nucleotidase And The Petidases

5' Nucleotidase, leucine amino peptidase and gamma glutamyl transpeptidase (GGTP) are principally used to identify tbe hepatobiliary origin of the elevation of SAP when coexistent bone disease is present. GGTP has been proposed as a sensititve screening test for hepatobiliary disaease, as a potential marker for alcoholism or for monitoring abstinence from alcohol. However there are few reports in literature which document a distinct advantage of this test over other tests and *a routine use of the GGTP is not recommended at the present time.*

Albumin

Albumin is synthesized *exclusively* by the liver at the rate of 100 - 200 mg / kg/d. The synthesis is influenced by among other factors, the state of nutrition, thyroid hormone, glucocorticoids, plasma colloid osmotic pressure. and toxins. The mechanism of degradation in health is unknown; increased degradation is seen in exfoliative dermatitis, severe burns, nephrotic syndrome and protein losing enteropathy. Thus albumin concentration may be importantly influenced by factors other than the functional state of the liver and therefore the measurement of albumin levels is not specific for liver disease. If on the other hand , other factors can be excluded, hypoalbuminemia may be a useful indicator of changing liver function.

Monitoring the response of the prothrombin time after parenteral vitamin K is very nonspecific has little to advocate its routine use as an index of liver function.

8

SEROLOGIC EVALUATION OF VIRAL HEPATITIS

Hepatitis A (HAV)

By the time the patient is sufficiently symptomatic to seek medical attention, the virus is no longer detectable in blood and rarely, if at all in the feces. Anti-HAV (the antibody produced in response to the virus) is detectable as its IgM fraction throughout the period of the acute illness, increasing rapidly for four to six weeks and then, declining to undetectable levels in three to six months. The finding of positive IgM specific antibody in the serum is therefore indicative of an acute HAV infection of relatively recent onset.

IgG antibody becomes detectable in the early convalescent phase of the infection. It remains elevated during the lifetime of the patient providing him protective immunity against the virus.

Hepatitis B (HBV)

The surface antigen of HBV - HBsAg, (the Australia antigen) appears two to six weeks before the appearance of clinical evidence of hepatitis, reaches a peak during the period when the communicability of the virus is at its highest (the acute stage of the infection)- then gradually declines to undetectable levels in four to six months.

An antigenic component of the capsid - *Hepatitis B e antigen* (HBeAG) appears shortly after the appearance of HBsAg. This antigen is an indicator of viral replication. When the infection reaches a convalescent stage, HBeAg is replaced by anti-HBe. The infection resolves with the disappearance of HBsAG and the appearance of anti-HBs.

Presence of HBsAg is an indicator of active HBV infection. Persons who maintain persistently elevated HBsAg levels or whose serum HBeAG remains detectable eight to ten weeks after symptoms begin to resolve are likely to become carriers. Incidence of chronic liver disease is highest in this group.

The core antigen (HBcAg) to the virus is almost never detected in circulation unless a detergent is first used to break up the surface antigen. The antibody to this antigen (IgM anti-HBc) appears immediately after the transaminases are elevated. It indicates acute viral replication and declines gradually over the next 6-8 months. Fewer than 5% of patients with chronic hepatitis have a titer of greater than 1 in 1000 (which is the starting dilution for most tests which test IgM anti-HBc). Thus the presence of high titre of IgM specific anti-HBc is indicative of recent acute infection. (in chronic patients this may be due to reactivation of HBV or steroid withdrawal).

All patients who test positive for HBsAg should necessarily also test positive for anti-HBc. False positive HBsAg reactions may occur in patients who have been heparinized and in sera of patients who have serious coagulation disorders.

Patients who test positive for anti-HBcAg but negative for HBsAg should be evaluated further with the following possibilities in mind.

1. Acute HBV infection in which the sample was collected in the early convalescent stage of the illness.

2. Chronic HBV infection in which the serum concentration of HBsAg is too low to be detected by conventional assays.

3. Previous HBV infection in which the anti- HBs level has become undetectable.

4. False positive anti-HBc

The viral hepatitis diagnostic profile should be sufficient in 90% of patients with hepatitis. In the event of serological negativity, alternative diagnoses as non A, non B hepatitis, other viral infections or drug induced liver disease should be considered. With a rationale approach, liver biopsy, once commonly used in the evaluation of acute hepatitis, should rarely, if ever be necessary.

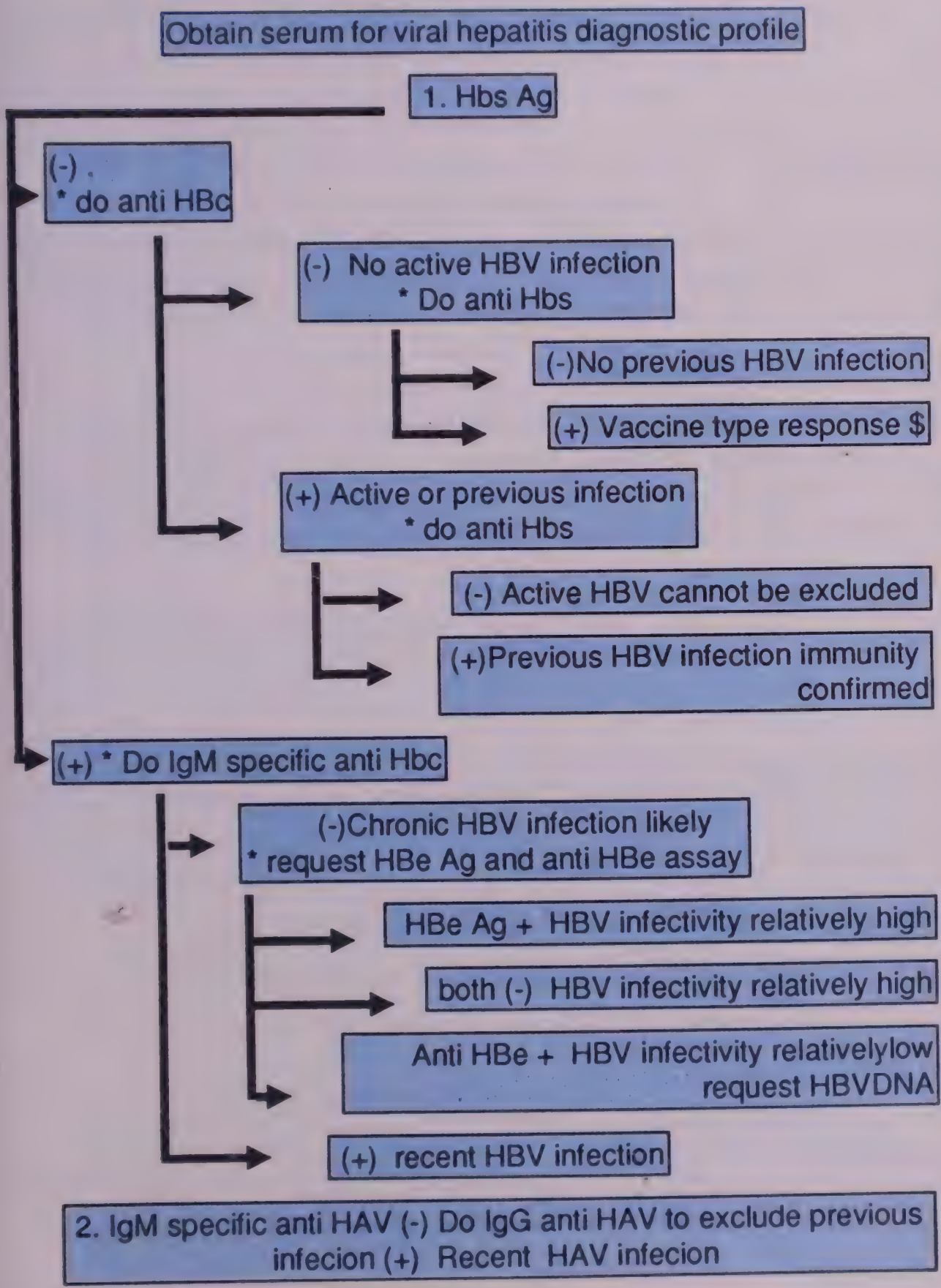
Viral Hepatitis Screening Profile

Interpretation Of Results

IgM specific anti-HAV	HBsAg	Anti-HBc	Interpretation
+	-	-	Recent acute HAV infection
-	+	-	Early acute HBV infection
-	+	+	HBV infection acute or chronic
-	-	+	Active HBV infection cannot be excluded. Test for anti HBs and anti HBe
-	-	-	Possible non A, non B, other viral infections, toxic liver disease
+	+	+	Recent acute HAV in HBV carrier

HAV - Hepatitis A virus
HBV - Hepatitis B virus

SEROLOGIC DIAGNOSIS OF HEPATITIS (HAV AND HBV) AN ALGORITHM.


Obtain serum for viral hepatitis diagnostic profile
1. Hbs Ag
(-)
* do anti HBc
(-) No active HBV infection
* Do anti Hbs
(-)No previous HBV infection
(+) Vaccine type response $
(+) Active or previous infection
* do anti Hbs
(-) Active HBV cannot be excluded
(+)Previous HBV infection immunity confirmed
(+) * Do IgM specific anti Hbc
(-)Chronic HBV infection likely
* request HBe Ag and anti HBe assay
HBe Ag + HBV infectivity relatively high
both (-) HBV infectivity relatively high
Anti HBe + HBV infectivity relativelylow request HBVDNA
(+) recent HBV infection
2. IgM specific anti HAV (-) Do IgG anti HAV to exclude previous infecion (+) Recent HAV infecion

9 TUBERCULIN SKIN TESTING

Test Methods

Tuberculin preparations. Purified protein derivatiive (PPD) is the most commonly used test material. It is available in three strengths : 1 tuberculin unit (TU) (first strength); 5 TU (intermediate strength) and 250 TU (second strength).

The 5 TU is the standard test dose.

Two test methods are available; the multiple puncture technique and theMantoux test. The latter remains the procedure of choice for assaying tuberculin hypersensitivity. The Mantoux test is performed by injecting 0.1 ml of PPD intradermally on the volar surface of the forearm. A control with known skin antigen should be used on the opposite arm.

Indications For Tuberculin Skin Testing

- Diagnosis of active infection
- Diagnosis of present or remote inactive infection
- Diagnosis of infection in contacts of newly diagnosed cases
- Diagnosis of past infection before initiation of immunosuppressive therapy
- Screening of high risk groups
- Accumulation of epidemiologic data.

Reading The Test

Tuberculin skin tests should be read at 48 - 72 hours after administration. Only induration and not erythema should be measured. For the Mantoux test the extent of the indurations in two directions should be measured and recorded. This is done by the ball point pen technique. With a ball point pen four lines, two vertical and two horizontal are drawn toward the margin of the induration, starting one to two centimetres from the edges. When the ball pen reaches the edge of the induration resistance is encountered and the movement of the ball pen becomes difficult. The distance between the lines at the exact edge of the induration in the four quadrants is recorded in mm.

Converters

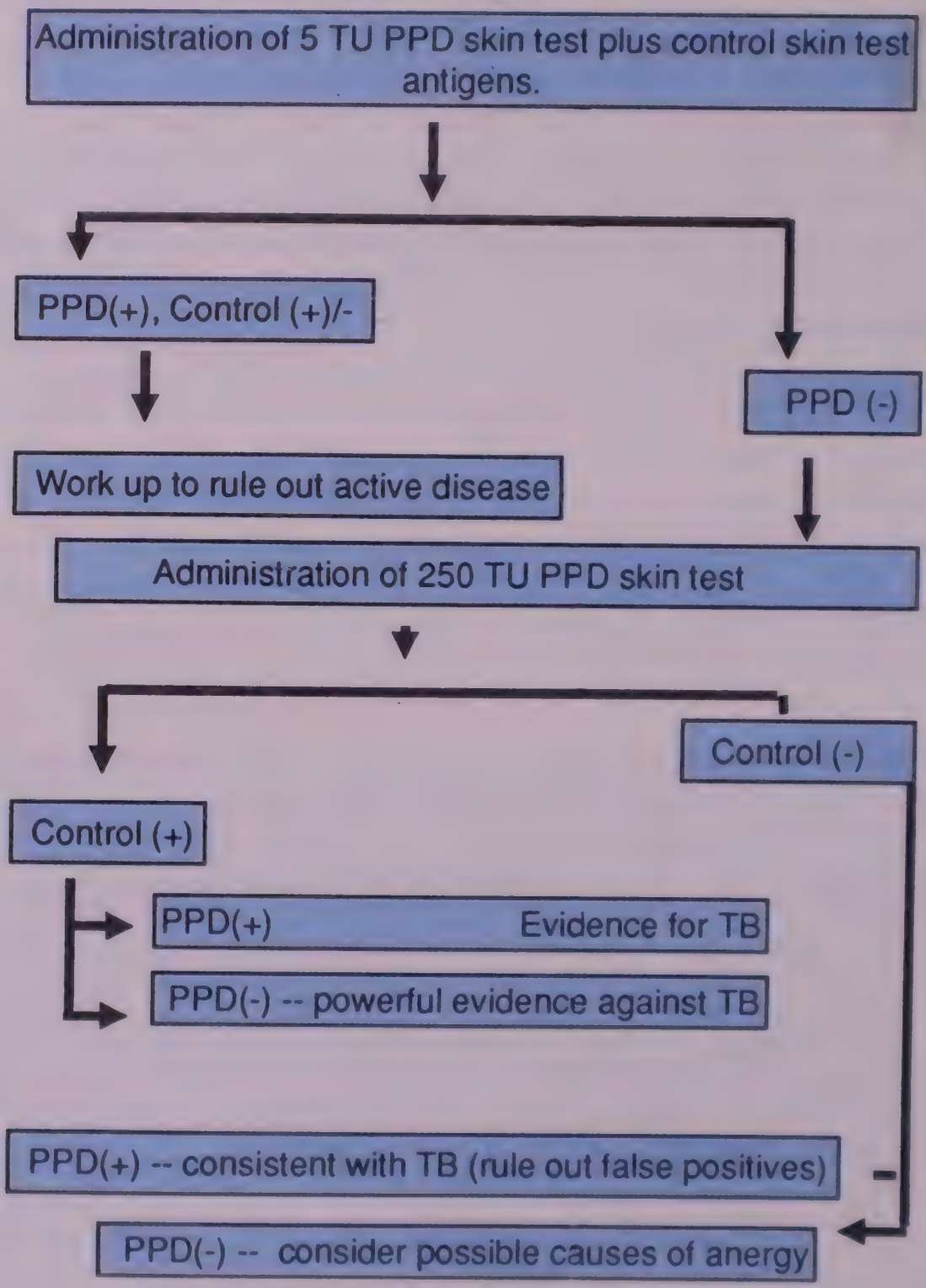
A converter is a person whose skin test changes from negative to positve on retesting. If the change occurs within a two year period the patient is a "recent converter" and is at the risk of active disease in the next few years.

Conversion of a Mantoux skin test is defined as an increase in the size of the induration of 6 mm or more, or from less than 10 mm to more than 10 mm.

Interpretation Of The Test.

Situation	Positive if greater than
a. Routine screening	10 mm
b. History of exposure, immunosuppression clinical findings +	5mm
c. absence of signs and symptoms or residence in an area endemic with mycobacteria other than tuberculosis	12mm

APPROACH TO TUBERCULIN SKIN TESTING


Administration of 5 TU PPD skin test plus control skin test antigens.
PPD(+), Control (+)/-
PPD (-)
Work up to rule out active disease
Administration of 250 TU PPD skin test
Control (-)
Control (+)
PPD(+) Evidence for TB
PPD(-) -- powerful evidence against TB
PPD(+) -- consistent with TB (rule out false positives)
PPD(-) -- consider possible causes of anergy

False Positives

The Booster Effect is an increase in the skin test reactivity within a week to one year after the initial skin test because of immunologic recall or an enhanced cross reaction due to infection with other mycobacteria.

It is evident that an individual could incorrectly be considered a recent skin test converter as a result of the boosting effect.

Prevention: The Centre for Disease Control (USA) recommends that when an individual has an initial Mantoux skin test of less than 10 mm, a second skin test should be done at least one week but no more than three weeks later. The dual skin testing technique will eliminate false recent converters and thus prevent unnecessary isoniazid therapy.

Anergy

Approximately 25% of patients with active pulmonary tuberculosis fail to respond to the standard Mantoux skin test. The value of a 250- TU skin test is the virtual exclusion of tuberculosis by a negative result especially in patients who respond to other antigens such as candida or mumps. Specific anergy to a PPD skin test occurs in fewer than 5% of pateints with active tuberculosis.

BCG And Tuberculin Testing

Those who have recieved BCG vaccination usually have large reactions (15mm induration), which may indicate infection with M. tuberculosis or allergy to the vaccine. If infection is likely on the basis of family history of tuberculosis or a recent close contact with tuberculosis, the positve skin test should be attributed to M.tuberculosis infection and not the BCG vaccination.

Reasons For False Negative Tuberculin Reactions

Technical Errors

Inaccurate reaction measurements

Faulty antigen

Faulty administration

Reaction read too early (test conversion requires 6-8 weeks)

Impaired Cellular Immunity

a. Non specific

Hypoalbuminemia

Old age (70 years)

Anemia

Fever

Azotemia

b. Drugs and other therapy

Immunosuppressants

Irradiation

Antiviral vaccines

c. Specific disease

Viral infections (rubella, mumps, infectious mononucleosis, influenza etc.)

Overwhelming bacterial infections

Hodgkins disease

Leukemias

10

CULTURES FOR MICRO ORGANISMS

Blood Cultures

Bacteremia may be

a. transient, as during dental procedures, draining abscesses and activities of daily living like bowel movements and brushing teeth.

b. intermittent, as in undrained abscesses.

c. continuous, as in endovascular infections.

Clinically significant bacteremia can be detected by sampling the patients blood at one or more places and incubating them in the appropriate culture media. (A single sample is a culture; more than one a culture series.)

Clinical applications of assessing bacteremia:

1. Establishing the primary diagnosis in certain high risk populations.

   Febrile hospitalized patients, febrile neutropenic patients, and patients with nosocomial infections.

2. Establishing the bacteriological cause of a focal infection and providing prognostic information about the potential complications of a focal infection.

   Osteomyelitis, meningitis

3. Exclude serious illness

   Infective endocarditis

4. Monitor therapy.

When Should You Order for Cultures

A culture report is most likely to yeild a true positive result when :

- the patient is febrile (>38.3^{0}C)
- there is major comorbidity
- there is an acute abdomen on clinical exam
- the leukocyte count is >15000 or <5000
- a greater proportion of band neutrophils is seen in the smear
- the ongoing illness has a high mortality

CONTAMINANTS OF BLOOD CULTURES

Usual contaminants

Skin flora : Diphtheroids, Staphylococcus epidermidis, Bacillus species.

Rare contaminants

Enterobacteriae isolates, gram negative anaerobes, Streptococcus pyogenes, Streptococcus pneumoniae.

IS THE CULTURE REPORT RIGHT?

Guidelines For Identifying False Positive Cultures

Test characteristics

Contaminants are rarely identified in subsequent cultures.

Multiple organisms isolated from one culture suggests contamination. (Polymicrobial infection is unusual).

Delayed detection of bacterial growth is commoner for contaminants.

Clinical findings

Clinical course is not consistent with sepsis.

Primary infection with same flora not found.

Predisposing factors that would lead to bacteremia are absent- such as prosthetic devices, IV drug abuse, immunosuppression, recent hospitalization.

No leukocytosis or left shift in the differential count.

Guidelines for The Use Of Blood Cultures To Identify Bacteremia

1. The blood culture is a test that is unusually dependent on the user.Sterile technique, choice, timing and the number of blood samples are important. The physician must be reasonably aware of the pretest possibility of bacteremia in the particular patient and must know the type of bacteria which may be the pathogens in that particular clinical setting.

2. Sensitivity of the culture can be maximized by drawing multiple cultures, each containing at least 10 mL. *(Mayo Clinic guidlines)*

3. Specificity of the test can be increased by adhering to strict aseptic precautions. Do not obtain samples from an indwelling venous catheter.

4. More than one test should be positive or negative to arrive at a diagnosis or exclude the possibility of bacteremia. The number of cultures depends on the clinical situation, the possibility of bacteremia and the clinician's judgement.

Urine Cultures

Guidelines

1. Cultures are not routinely indicated in all patients with dysuria. There is evidence to suggest that non pregnant, non diabetic adult females without evidence of pyelonephritis (fever, chill, flank pains) may be treated after a urine analysis (pus cells - >7 per HPF) and a gram stain. (*Ann. Int. Med.*)

2. Cultures are indicated in the following:

a. all adult males.*

b. all children below 14 years.*

c. suspicion of pyelonephritis.*

d. diabetics.

e. pregnant women.

f. recurrent attacks. (>3 in six months)*

g. not responding to therapy (ampicillin, ciprofloxacin or sulphonamides for 5 days).

h. sterile pyuria. (do stain for AFB, culture).

i. indewelling catheter causing UTI.

**Further investigation required - minimum- intravenous pyelogram.*

11 SERUM ELECTROLYTES

Serum electrolyte measurements are amongst the most frequently ordered blood chemistry tests. Only in selected populations, tests for individual electrolytes may be beneficial in diagnosis and management.

Potassium

Most of the body's potassium is inside the cells. However only the serum or the plasma potassium concentration is measured. Serum levels usually parallel changes in total body potassium, influenced by several factors. Determinants of serum potassium balance are, potassium intake and excretion, (especially renal excretion).

Normal range: 3.5-5.0 meq/L.

Errors in measurement: False elevations occur due to hemolysis during venipuncture or during clotting by release of intracellular potassium. This may be suspected if the serum is pink in colour. False elevations are also frequent if the sample is drawn from a vein with the fist clenched (so called psuedo hyperkalemia). False elevations also occur in blood with extremely high platelet or leukocyte counts. Release of potassium by the abnormal number of leukocytes and platelets during clotting causes the artefacutal elevation.

The true value of potassium can be determined by inhibiting clotting with heparin and measuring the plasma potassium concentration.

Guidelines For Use

Screening Unselected Populations

Measuring serum potassium levels does not appear useful for general screening.

Screening Selected Outpatients

Interstitial renal disease. In diabetics with mild interstitial renal disease, hyperkalemia requiring specific therapy may be present. If hyperkalemia is not present at the initial diagnosis, the serum potassium should be measured once or twice a year to detect any trend toward hyperkalemia. This abnormality occurs in 50% of diabetics with mild renal insufficiency. The prevalence is unknown in non-diabetic renal disease.

Detection of hypertension due to primary hyperaldosteronism. Though an uncommon cause of hypertension (0.5-1%), screening for this disease in hypertensive patients is reasonable. Most patients with primary hyperaldosteronism have moderate to mild hypokalemia (sensitivity 73%) except hypertensives on treatment with diuretics.

Renal tubular acidosis. Hypokalemia occurs in virtually all patients with classic renal tubular acidosis. Therefore, serum potassium determination is indicated in children with poor growth, muscle weakness, kidney stones, or other suggestive symptoms.

Use of Serum Potassium in Out Patient Department

Signs or symptoms like generalized weakness or proximal muscle weakness, new atrial tachyarrhythmias, nocturia, polyuria or ileus, in patients with conditions known to be associated with altered potassium metabolism (gastrointestinal disease, renal tubular acidosis, diuretic therapy) should prompt the clinician to test for potassium levels. In hypertensives on diuretic therapy, serum potassium falls by about 0.5-0.7 meq/L and reaches a constant level at 6-12 weeks. Therefore measurement of serum potassium should be done before initiation of treatment, again after 6-12 weeks, and then yearly in the absence of other important clinical changes. Concentrations should be measured every 6 months in patients receiving diuretics and concurrent digitalis, because hypokalemia increases the incidence of serious arrhythmias.

Use of Serum Potassium in Hospitalized Patients

Serum potassium concentration should be measured on admission in every acutely ill patient and again whenever there is an important change in clinical status. Daily measurements are indicated, in patients with changing renal function (as in acute renal failure), those treated for cardiac arrhythmias (those receiving digitalis), and in patients with persistent gastrointestinal losses.

Patients on intensive fluid replacement therapy, particularly those requiring carbohydrate loads or insulin, patients being treated for severe hyperkalemia or hypokalemia, severe metabolic acidosis and those on intensive diuretic therapy, should have more frequent measurements of serum potassium.

Chlorides

Determination of the plasma or serum chloride concentration alone is never indicated. Nevertheless, the chloride concentration is helpful, when available as part of an electrolyte panel; these help in the proper interpretation of the bicarbonate concentration (total CO2) and in calculation of the anion gap.

Sodium

Sodium is the major extracellular cation. Sodium levels reflect the status of water balance throughout the body.

Sodium level in blood is usually half the body fluid's osmolality.

Normal range: 135-145 meq/L.

Serum sodium concentration is not an index of total body sodium and should never be used to assess sodium balance or to predict a patient's need for more or less sodium; nor can the serum sodium concentration be used alone to assess the status of the extracellular fluid volume. This must be determined by clinical evaluation.

Guidelines for Use

Use In Osmolality Calculations: Serum sodium may not reflect fluid osmolality in two circumstances;

1. When a solute other than sodium is present in excess that is relatively restricted to the extracellular space as in hyperglycemia. This causes movement of water into the extracellular space, diluting sodium. In such a situation, the osmolality of body fluids must be assessed by estimating plasma osmolality. The magnitude of drop in serum sodium in hyperglycemia can be estimatedby using the following formula

$$X(\text{serum Na}) = -1.6 \times (X \text{ glucose}/100)$$

where, X (serum Na) = change in sodium concentration in meq/L

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X glucose = change in plasma glucose concentration in milligrams/100ml

2. When large quantities of lipids or proteins occupy a higher than normal fraction of plasma, thereby falsely lowering the serum sodium concentration.

Screening Unselected Populations: This is not of any use except in picking up patients with the syndrome of inappropriate secretion of antidiuretic hormone (SIADH); in this condition chronic hyponatremia may be clinically silent. However, as the prevalence of this syndrome is very low, screening for this disease in an unselected ambulatory population is not recommended.

Use of Serum Sodium in the Out Patient

In hypertension, elevated sodium is often associated with primary aldosteronism, but its concentration alone is not useful in making a diagnosis. In patients with polyuria and polydipsia not due to diabetes mellitus, the serum sodium concentration may distinguish between diabetes insipidus (hypernatremic) and primary polydipsia (hyponatremic). This is of little value when compared with a standard water deprivation test or measurement of plasma vasopressin levels. Regular measurement of serum sodium levels is appropriate in patients receiving chronic lithium therapy for bipolar affective disorders. Lithium causes nephrogenic diabetes insipidus, with consequent loss of water, that predisposes patients to dehydration and hypernatremia.

Hyponatremia occurs in congestive heart failure, cirrhosis and nephrotic syndrome as a consequence of impaired water excretion that develops as the underlying disease process worsens. Here hyponatremia develops insidiously and influences management. Frequent measurements are indicated. In chronic renal insufficiency, the reduced capacity for excretion of free water becomes important as the glomerular filtration rate falls to 10-15% of normal, even when fluid intake is normal, because hyponatremia may develop insidiously. Therefore when the serum creatinine level reaches 7-8 mg/dL. serum sodium concentration should be measured every 2-3 months.

Other indications for measurement in outpatients include rapid changes in weight, fluid balance (severe vomiting, diarrhea, polyuria), or mental status, lithium therapy and clinical evidence of dehydration or volume depletion.

Use of Serum Sodium in Hospitalized Patietnts

Serum sodium concentration need not be determined in otherwise healthy patients admitted for elective surgery or diagnostic procedures. It should be done in all acutely and chronically ill inpatients during admission or when there is a change in clinical status. Repeated measurements are indicated in any hospitalized patient who has an initially abnormal value, rapid change in weight or fluid balance, or serious cardiac, renal, or hepatic disorders. Measurements must be done once daily in patients receiving parenteral fluids, but some patients receiving intensive corrective fluid therapy (for diabetic ketoacidosis, intensive diuresis, correction of severe hyponatremia) require measurements every few hours.

12 SERUM ENZYMES IN MYOCARDIAL INFARCTION

In myocardial infarction there is an elevation in the serum levels of the following enzymes - creatine kinase (CK), lactate dehydrogenase (LDH) & aspartate aminotransferase (AST).

Creatine kinase is a dimeric enzyme that catalyses the transfer of high energy phosphate groups. It is found predominantly in tissues consuming large amount of energy. It has two subunits namely type M (muscle) & type B (brain). Myocardial CK is composed of 85% MM and 15% MB.

Lactate dehydrogenase catalyses the reversible reduction of pyruvate to lactate in the last step of glycolysis. Its subunits are type M (muscle) & type H (heart) and has five isoenzymes, LDH1-5. LDH1 and LDH2 predominate in the heart. Skeletal muscle and liver have mostly LDH5.

Serum AST has a major role in the transfer of amine groups in amino acid synthesis.

Post-infarction Characteristics Of Serum Enzymes

Name	Rises (hrs)	Peaks (hrs)	Returns To Normal (days)
Creatine kinase	6-15	24	1-4
CK- MB	3-15	12-24	1-3
LDH	12-24	48-72	7-14
AST	8-12	24-48	3-5

False Positive CK-MB elevation.

Cardiac	Noncardiac
Cardioversion	Skeletal muscle trauma
Cardiac contusion	Skeletal muscle diseases
Cardiac surgery	Reye's syndrome
Myopericarditis	Hypothyroidism
Coronary angioplasty	Peripartum period
Prolonged supraventricular tachycardias	Acute cholecystitis
	Carcinomas (eg. prostatic or breast)
	Drugs (eg. aspirin or tranquilizers)
	Alcoholism

When To Use Serum Enzyme Assays

1. A single set of cardiac enzyme values is not sufficiently sensitive to exclude MI.

2. If MI is suspected samples of total CK & CK MB levels should be measured on admission, 12-24 hours later and thereafter once or twice at 12 hour intervals.

3. If MI may have occured more than 24 hours before admission and if CK and CK-MB levels are not diagnostic, a total LDH level must be ordered. If elevated an assay of LDH isoenzymes should be obtained. If the LDH1/LDH2 ratio is greater than 0.76 a recent myocardial infarction can be diagnosed.

4. Repeat CK determinations are indicated for any recurrence of chest pain, congestive heart failure or acute arrhythmia at 0, 12 & 24 hours.

5. In patients with non Q wave infarction, because of the high propensity for early reinfarction CK-MB values should be obtained every 12 hours throughout the period of hospital stay *(Diltiazem Reinfarction Study)*.

6. Routine use of serum enzyme assays other than CK, CK MB and LDH isoezymes are not recommended.

7. If more than 2 hours may pass before CK isoenzymes will be assayed, the serum sample should be preserved on ice.

8. In the setting of cardiac surgery MI should be diagnosed if any two of the following are present- CK MB elevation persisting for more than 12 hours, new Q waves on an ECG or a regional defect on technitium pyrophosphate scintigraphy.

9. CK MB assays can be used to diagnose MI in non cardiac surgery, cardiac catheterization and after electrical countershock.

13 THYROID FUNCTION TESTS

The Data Base

The thyroid hormones, thyroxine (T4) and tri-iodo thyronine (T3) are secreted under the stimulatory influence of pituitary thyroid stimulating hormone (TSH), which in turn is regulated by thyrotropin releasing hormone (TRH), a hypothalamic peptide and by thyroid hormone itself through a feedback effect.

Most of the circulating thyroid hormones are bound to proteins - thyroxine binding globulin (TBG) (75%), thyroid binding prealbumin (15%) and albumin (10%). The metabolically active component is the free hormone (T3 is the metabolically active component) and this forms only a very minor portion of the total circulating hormone levels.

Alterations in the concentrations of thyroid binding proteins principally TBG, result in changes in the thyroid hormone levels. An increase in TBG increases total hormone levels; a decrease has the opposite effect. The amounts of free hormone do not change secondary to alterations in binding proteins however, so that the thyrometabolic status remains the same.

The total serum T4 usually accurately reflects the functional state of the thyroid. However when there is an alteration in the binding proteins a T4 value may be misleading. In such a situation, an estimate of the thyroid binding protein capacity should be made. This is commonly done by measuring the T3 resin uptake (T3RU). The Free T4 index (FT4I) is then measured using the formula:

FT4I = Total T4 X T3 RU (measured)/mean normal T3RU

The mean normal T3RU is usually about 30%.

The free T4 index closely correlates with the free T4 levels, and would be most accurate assessment of thyrometabolic status.

Altered Thyroid Binding Globulin (TBG) States

TBG Excess - results in elevated T4 and T3

- Pregnancy
- Estrogen producing tumors
- Acute and chronic active hepatitis
- Acute intermittent hepatic porphyria
- Drugs - Estrogen, Heroin, methadone, clofibrate
- Idiopathic
- Familial

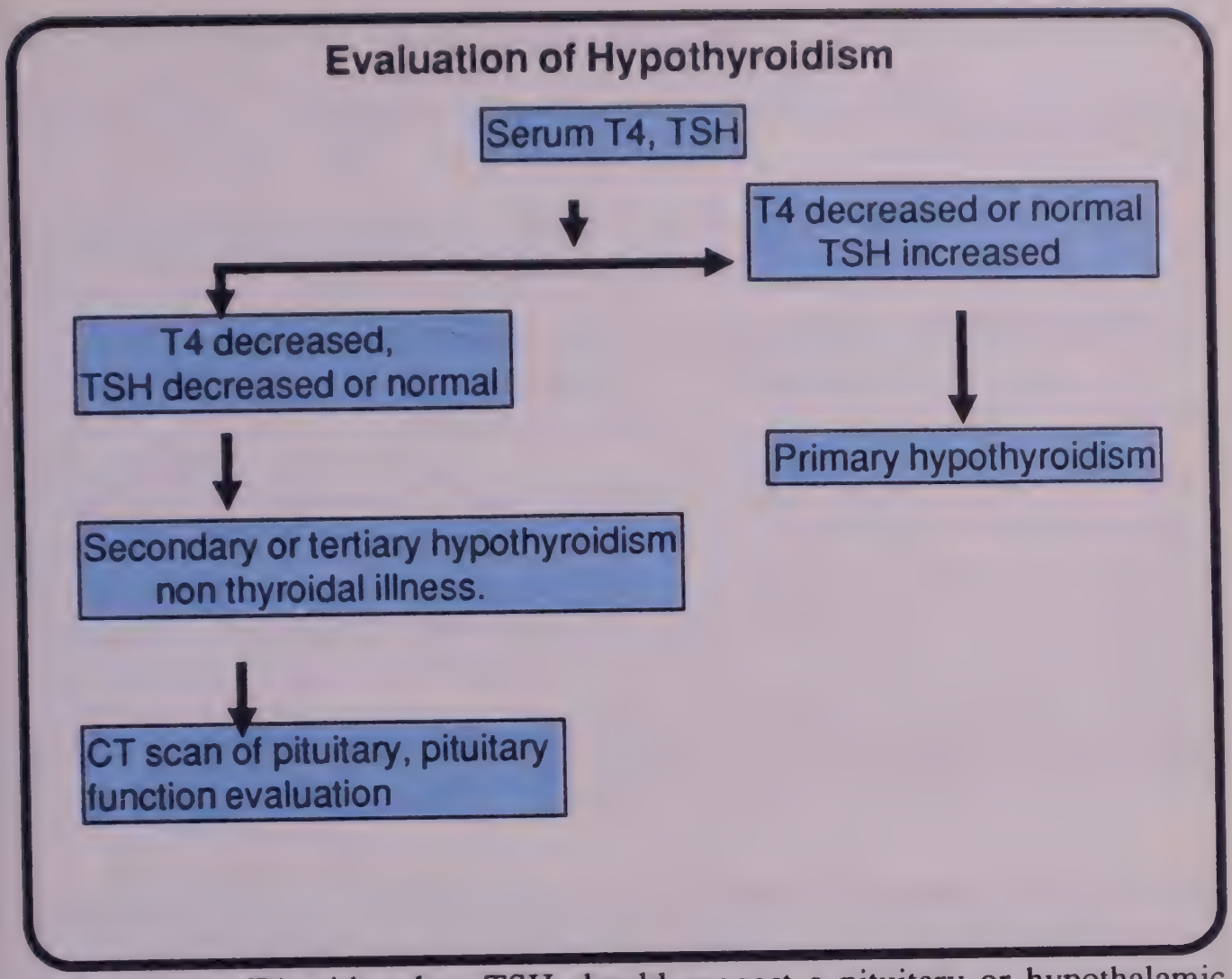
TBG deficiency - results in reduced T4 and T3

- Acromegaly (mainlyThyroid Binding Prealbumin)
- Testosterone producing tumors
- Hypoproteinemia
- Cirrhosis of the liver
- Nephrosis
- Drugs - androgens, glucocorticoids (large doses)

Evaluation of Thyroid Function

Hypothyroidism.

The diagnosis of primary hypothyroidism is made by the presence of a low T4 and an elevated serum TSH. TSH is the most sensitive test in the diagnosis of primary hypothyroidism. In early hypothyroidism, T4 concentrations may be normal in the presence of elevated TSH. This is because TSH is extremely sensitive to even minor decrements in T4 levels. These patients usually do not manifest the signs and symptoms of hypothyroidism.



A low serum T4 with a low TSH should suggest a pituitary or hypothalamic cause. Patients with low T4 and TSH due to non thyroid illness must be differentiated from pituitary and hypothalamic hypothyroidism.

Serum T3 may be normal in up to one third of the patients with hypothyroidism and its measurement has little application in the evaluation of hypothyroidism.

Hyperthyroidism.

The serum T4 and estimation of FT4I is a sufficient screening procedure for patients with suspected hyperthyroidism. The serum T3 is elevated in virtually all patients with hyperthyroidism irrespective of the etiology (except when there is a severe intercurrent illness which interferes with the peripheral conversion of T4 to T3). In general, it is unnecessary to obtain T3 levels to make a diagnosis of hyperthyroidism.

A T3 level is useful, however, in the following situations

1. In patients with symptoms suggestive of hyperthyroidism in whom T4 levels are normal or borderline.

2. In patients in whom T4 excess is detected on routine screening, where symptoms or signs of thyroid excess are absent.

Such patients may be euthyroid and the isolated hyperthyroxinemia may be due to alterations in thyroid binding proteins (vide above) or due to blocked peripheral conversion of T4 - T3 as in acute psychosis.

T4 and T3 excess without hyperthyroidism is also seen in patients with an inherited disorder of peripheral resistance to hyperthyroidism. Such patients are euthyroid or may be mildly hyperthyroid. Though unusual, such conditions of hyperthyroxinemia without hyperthyroidism are being recognized with increasing frequency.

3. In Graves disease T3 levels are disproportionately increased; this may help in differentiating this condition from painless thyroiditis.

Radioactive Iodine Uptake (RAIU) In Hyperthyroid States

High RAIU

- Graves disease
- Toxic multinodular goiter
- Toxic adenoma (may be normal)
- Hashitoxicosis
- Choriocarcinoma
- Hydaditiform mole
- TSH producing pituitary tumor

Low RAIU

- Subacute thyroiditis
- Painless thyroiditis
- Graves disease with acute iodine load
- Iodine induced hyperthyroidism
- Thyroid hormone therapy
- Metastatic functioning thyroid carcinoma

The **thyroidal radioactive iodine uptake** (RAIU) should be done in all patients with hyperthyroidism unless there is sufficient evidence, such as infiltrative exophthtalmos or pretibial dermopathy, separating Grave's diseases from other causes of hyperthyroidism.

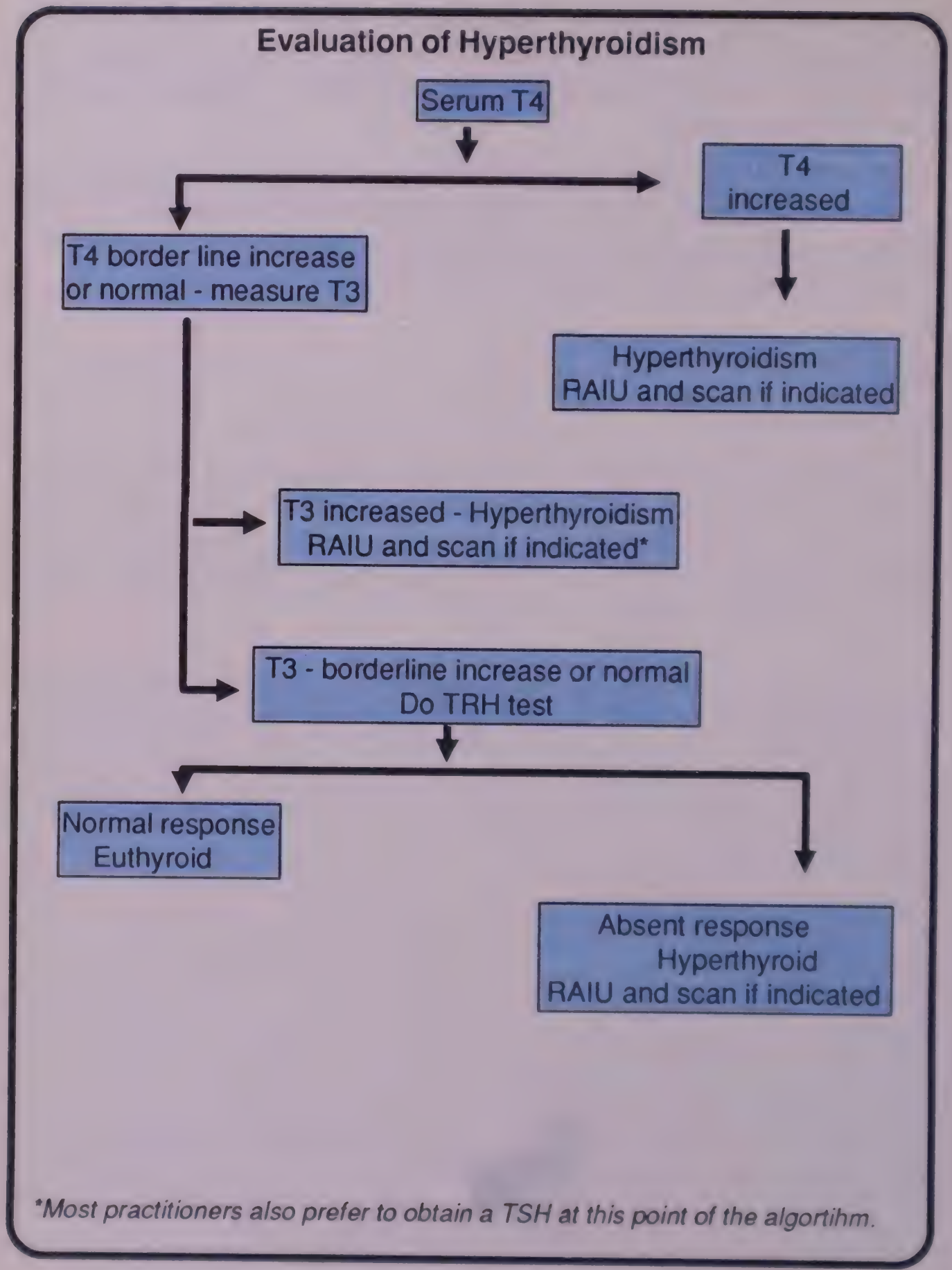
The **thyrotropin releasing hormone (TRH) test** is useful in patients with suspected hyperthyroidism in whom thyroid function tests are equivocal. A positive response, defined as a TSH rise of 5 microunits /mL above baseline, definitely excludes hyperthyroidism (where the TSH response is abolished).

The TRH test

Test Method

Obtain baseline TSH.

Administer 500 mcg of TRH IV over 15 - 30 seconds. Plasma TSH levels are drawn 30 and 60 minutes after administration.The patient must be supine through out the test as vasovagal reactions may occur when the test is performed with the patient seated.Brief side effects of TRH administration include nausea, urge to micturate, and mild flushing.


Evaluation of Hyperthyroidism
Serum T4
T4 increased
T4 border line increase or normal - measure T3
Hyperthyroidism RAIU and scan if indicated
T3 increased - Hyperthyroidism RAIU and scan if indicated*
T3 - borderline increase or normal Do TRH test
Normal response Euthyroid
Absent response Hyperthyroid RAIU and scan if indicated
*Most practitioners also prefer to obtain a TSH at this point of the algortihm.

14

CHOOSING THE RIGHT IMAGING TECHNIQUE

The last twenty years have witnessed a very large growth in the number and variety of imaging techniques that are available to assess various organs. Today no organ is beyond an appropriate study. As information accumulates on each imaging modality, we have come to realise that there is no single imaging technique that is uniformly valuable for all applications. This chapter provides some broad guidelines to be followed when choosing an imaging technique.

Remember:

Different imaging techniques have different capabilities. Any given modality is available with a range of functions, and can perform well only within that range.

The yield of an imaging technique depends, largely on the competence of the imaging specialist. This is especially true of ultrasound.

Although there are well established guidelines for each of the common modalities, every patient and clinical situation is unique, and the imaging specialist has to use his discretion.

Imaging Techniques Available to the Modern Practitioner

- Plain x-rays and contrast studies.
- Ultrasonography.
- Radionuclide imaging.
- CT scanning.
- Magnetic resonance imaging.

DIAGNOSTIC YEILD OF IMAGING PROCEDURES

(On a scale of four 0 = no information to 4 = most information; # indicates - still under investigation)

Area	MRI	CT	US	RNI	X-ray
Central nervous system					
Brain	4	3-4	1	0	1
Spine	4	4	1	1	2
Spinal cord	4	1	0	0	0
Thorax					
Lungs	#	4	1	1	3
Mediastinum	#	4	1	1	2
Breast	#	1	2	0	4
Upper Abdomen					
Right upper quadrant	#	4	3	2-3	1
Gall bladder	#	3	4	4	1
Left upper quadrant	#	4	2	2	1
Pancreas	#	4	3	0	1
Kidneys	#	4	3	2	3
Lower Abdomen					
Female pelvis	#	3	4	1	1
Male pelvis	#	4	2	1	1

MRI - magnetic resonance imaging, CT - computerized axial tomography, US - ultrasound, RNI - radionuclide imaging.

Specific applications

The Central Nervous System

Preferred methods: CT scanning and MRI.

The Thorax

Plain x-ray

Plain X-rayis the first investigative tool. CT studies are called for only to clarify an x-ray that is questionably abnormal.

Limitations:

Serious limitations in imaging the mediastinum

CT scan

Uses

1. In imaging the lung, where it is better than conventional x-ray tomography.

2. In identifying solid lesions in the mediastinum.

3. For staging malignancies.

4. To distinguish neoplastic lesions from vascular structures. CT has supplanted angiography and thoracotomy in the management of chest diseases.

The Heart

Radionuclide imaging (Thallium scan)

Uses:

1. Current method of choice for identifying lesions in the heart muscle and left ventricle, that are due to ischemic disease.

2. For physiologic measurement of myocardial perfusion.

3. Combined with exercise testing, it is the most sensitive and specific method of detecting occult coronary artery disease.

Ultrasound (Echocardiography)

Provides valuable information on volume and motion of chambers of heart, valves and pericardium.

Limitations

Ability to identify ischemic heart disease is minimal.

The Breast

Mamography

Primary radiologic tool in imaging the breast. It is the only examination capable of detecting infiltrating or insitu cancer less than 1cm in diameter,as well as microcalcifications that are often the only signs of early malignacy. It is the only imaging modality acceptable for screening purposes. Low dose film mamography with a lower risk of radiation is slowly replacing conventional zero mamography.

Limitations

This is of limited value in radiographically dense breasts-primarily in women under 30.

False negative rate is 5-10%.

Ultrasound

It is not as accurate as mamography and generally finds its application as a supplemental study, its major use, being its ability to distinguish between solid and cystic lesions. It is recommended as the primary modality in women under 28yrs.

The Gall Bladder

Preferred methods: Ultrasound and radionuclide scans.

Ultrasound

It is the primary imaging modality. It can identify calculi, pericholecystic edema, wall thickening, hepatic and common bile duct dilatation. It has an accuracy for detecting calculi that is in excess of 95%.

Limitations

Poor resolution of calculi outside the gall bladder.

Radionuclide scan

This is the 'state of the art' modality to document acute cholecystitis. The n-substituted immunodiacetic scans (IDA) have allowed identification of cystic duct obstruction. The current radionuclide of choice is a derivative of hepatolite.

Limitations

Expensive.

Does not actually show stones.

Pancreas

Preferred modalities: CT and Ultrasound.

Ultrasound

It is effective in demonstrating lesions in the head of the pancreas. Preferred in evaluating patients with elevated serum amylase, as it can demonstrate abnormal texture and enlargement of the pancreas.

Limitations

Becomes less accurate as the field of imaging crosses the midline and moves to the left ie. it is not effective in detecting lesions of the body and tail of the pancreas.

Highly operator dependent in this situation.

CT scan

It is the procedure of choice in pancreatic malignancy.

Liver

Preferred modalities: Ultrasound, CT and radionuclide scans.

Ultrasound and CT are similar in their capabilities to detect liver diseases. Ultrasound is excellent for showing bile duct dilatation and filling defect in the liver, while CT provides the best information about the parenchyma especially in malignancy.

Radionuclide scan

The sulphur colloid scan allows a functional and anatomic asessment of the liver.

Limitations

Does not reliably pick up lesions less than 2 cms in diameter. SPECT (single photon emission computed tomography) overcomes this at enhanced cost.

Kidneys

Preferred modalities: Ultrasound and CT scan

Intravenous pyelography (IVP)

Provides rough estimate of renal function and good depiction of upper urinary collecting system. Holds against CT and ultrasound as first modality because of its easy availability and low cost.

Limitations

Contraindicated in renal failure.

Ultrasound

Ultrasound can distinguish solid from cystic masses. It can detect hydronephrosis and is used as a screening procedure in evaluating patients with renal failure.

CT scan.

Optimal method of evaluating a solid renal mass and has the added advantage of being able to assess the venacava for extension of a malignancy.

The adrenal is best imaged by a CT.

Retroperitoneum

The ultrasound does not provide sufficient detail because of the presence of overlying fat and bone interfaces. CT scanning is the preferred method.

For evaluating ascites ultrasound is the preferred modality. CT scores over in imaging the left side of the abdomen because of the presence of gas filled bowel.

The Pelvis

Ultrasound is very sensitive in evaluating the female pelvis because the distended urinary bladder pushes the air filled bowel out of the way and provides an excellent 'window' to see the pelvis. There is concrete evidence to show that ultrasound has no hazardous effect on the fetus. This makes it more acceptable than other modalities in imaging the fetus. A CT scan is the appropriate modality in evaluating pelvic malignancies.

The Scrotum and testes.

Preferred modality- Ultrasound.

15 THE CHEST X-RAY

Chest radiographs make up 50% of all radiologic procedures. This chapter will discuss the utility and place of routine chest radiographs in clinical practice.

The major indications for a routine X-ray are to screen for silent disease, preoperative evaluation, evaluation of suspected chest disease and to establish a baseline for future comparision.

Screening

An effective screening test must be able to efficiently detect a disease before symptoms arise and thus lead to an improved health outcome. Several conditions detectable with chest radiography may not be apparent on clinical evaluation. Some of these conditions which may influence operative or anaesthetic decisions include mediastinal masses, tracheal deviation, pulmonary nodules, aortic aneurysm, pulmonary edema, pneumonia, atelectasis, dextrocardia, cardiomegaly and new fractures of the clavicle, ribs and vertebrae.

In assessing the utility of the preoperative chest film, however, these data are of little use because the presence of an abnormality does not always imply a negative outcome or the need for a change in the patient's management. Simply finding an abnormality on a chest film does not necessarily justify the examination.

Studies have shown that there is very little evidence to recommend a preoperative chest film routinely in non thoracic surgery. Preoperative films have a very low yield (< 1%) of unexpected radiographic abnormalities to recommend them.

Certain clinical features have been used to classify patients as being at low or high risk of having a serious abnormality on a preoperattive chest film. These risk factors include age over 60, history of cardiac or pulmonic disease, malignancy, stroke, signs and symptoms of chest disease and recent thoracic surgery; the presence of one or more of these risk factors may be taken as an indication to obtain a preoperative chest film.

There is no evidence on the requirement of routine preoperative films in smokers (though these are generally obtained).

Effect Of Routine Chest Radiographs On Hospital Admission.

The routine chest radiograph taken on hospital admission does identify unexpected abnormalities in a substantial proportion of patients (5-6%), but its potential for affecting patient management is very small. In a large randomized controlled trial, less than 1% of the population studied had a change in therapy indicated and less than 0.5% had truly occult chest disease identified by the film. Since the prevalance of occult disease is so small, the aggregate benefit of screening chest radiographs is at best slight.

Potentially Harmful Effects Of Screening Chest Radiographs

Significant abnormal findings on chest films in patients without chest disease (false positive results) may lead to an undesirable change in patient therapy, delay of surgery, prolonged hospitalization and additional diagnostic tests. Secondary negative effects include a possible deterioration of the primary disease while definitive therapy is delayed. Patients having unsuspected chest disease not identified by chest radiography (false negative results) are also subject to harmful effects. Not only will appropriate changes in patient care not be made, but the clinician may monitor the patient less intensively because of the false reassurance of the normal chest radiographs.

Chest X ray To Evaluate Suspected Chest Disease.

In patients with signs and symptoms of chest disease, chest radiography is helpful. A chest xray in this milieu can lead to changes in therapy or preoperative planning. The history and physical examination are however essential and cannot be replaced by chest radiography as a screening procedure.

RECOMMENDATIONS ON THE ROUTINE USE OF CHEST X-RAYS

- A chest film is not routinely indicated solely because of hospital admission.
- A chest radiograph is not indicated as a part of preoperative evaluation, before administration of anaesthesia or for a baseline assessment except in the high risk group (see text).
- A chest radiograph is not indicated solely because of advanced age.
- A routine preoperative chest radiograph is generally indicated for patients scheduled for intrathoracic or upper abdominal surgery to define the anatomy of that area.
- Chronic smokers may require a chest film preoperatively or on hospital admission.

16 TESTING FOR ALLERGY

Types : These include those testing for immediate (antibody mediated) and delayed (cell mediated) immunity.

Testing For Immediate Hypersensitivity

The most common skin testing is to identify allergens that cause or provoke symptoms associated with immediate hypersensitivity.

Preconditions

1. The patient's symptoms suggest a disorder usually mediated by IgE antibodies to substances in the patient's environment.

2. The patient must not have used antihistaminic agents for 2 -5 days prior to the performance of the test.

3. Skin tests must be placed no less than one inch apart. Inflamed skin must be avoided.

4. Positive (histamine) and negative controls must accompany each set of tests.

5. The allergen used must be standardized, safe, available in concentrations not high enough to have appropriate sensitivity to identify IgE antibodies but low enough to avoid non specific irritating skin reactions.

Test Methods : The intradermal test is done with an allergenic extract diluted in an alkaline buffered sterile saline solution with 0.03% human serum albumin as a stabilizer. A half mL syringe with a #27 -#30 needle is used to produce a visible bleb (0.01 -0.02 mL). A positive reaction consists of a wheal surrounded by significant erythema. A different syringe and needle should be used for each antigen.

Remember : There is a small but significant risk of inducing an adverse reaction in a patient who is highly sensitive.

The *scratch and abrasion tests* have very poor reproducibility and should be abandoned.

The *skin prick test*, consists of introducing the tip of a stylet or a 27 gauge needle at a 15 - 20 -degree angle through a drop of test allergen into the epidermis, which is then lifted up, tenting the skin until the needle point pops loose. A positive reaction consists of a wheal and erythema that reaches a maximum size in 10 to 20 minutes. Reactions of less than 5 mm are of questionable significance.

Guidelines

1. Skin testing is clinically effective when limited to allergens that are suspected from a patient's history. There is no role for a battery of tests with all known allergens.

2. For reasons of convenience (and none else) the simpler relatively atraumatic skin prick test may be done first. Intradermal testing can then be used for patients with a suggestive history and negative or equivocal results of skin prick tests to suspected allergens.

3. Excellent correlations exists between skin prick reaction to foods and oral symptom provoking challenges. For identification of IgE mediated food allergy use of skin prick tests alone may suffice.

4. Skin testing for drug allergy is *unreliable* except for macromolecular agents (such as enzymes, xenogenic sera and the penicillins).

Penicillin allergy can be confirmed or excluded reliably by skin prick tests followed (if the results are negative) by intradermal tests to the major determinant (penicilloyl polylysine) and a minor determinant mixture. The usual method of administering a "test dose " has no use or validity as a means of identifying penicillin allergy.

Unfortunately, the minor determinant mixture has not been approved for use and the testing with the major determinant alone is not sufficient to exclude allergy. A compromise will be to test with the major determinant and with benzyl penicillin (a component of the minor determinant) followed by (if negative) a small test dose as a further precaution) (Ann. Int. Med. 1989 110; 304 - 312).

Testing For Delayed Hypersensitivity

Uses

1. To identify or exclude exposure to microbial infections.For eg. Tuberculosis (see chapter on TB skin testing, this section).

2. To demonstrate cell mediated deficiency (anergy).

3. To identify the cause of allergic eczematous contact dermatitis.

Test Methods

This is done by the *patch test*. A non irritating concentration of each of the suspected material is placed on an absorbent pad and put on the skin of the back under occlusive non allergenic tape. The sites are inspected at 48 and 72 hours. A positive reaction consists of erythema, swelling and vesiculation.

Testing for clinical allergy to bacterial antigens and vaccines has very little use (Ann. Of Int. Med. 1989 110; 304 - 312).

Provocation Tests by inhalation or ingestion of the allergen is usually unnecessary. They are cumbersome and time consuming. These should be attempted only by experienced personnel in centres with adequate emergency resuscitative equipment. The only existing clinical indication is the confirmation of allergy to non steroidal anti-inflammatory agents (Skin testing has no value and the adverse reaction is usually asthma). Provocation tests are however, a valuable research tool.

Invitro Tests

The Radio allergosorbent test (RAST) may be useful in certain subsets of the population in whom skin testing is unreliable as in patients with severe dermographism or generalized dermatitis or who are unable to stop using antihistamines. Its a value as a research tool is unquestioned, but has little application in clinical practice.

17 THE ELECTROCARDIOGRAM

Electrocardiography is the principal method to record the sequence of activation of various parts of the heart; it represents the diagnostic yardstick for cardiac arrhythmias.

The ECG contour is altered by some anatomic and biochemical changes in the cardiac muscle. Clinico- pathologic correlates of these changes permit deduction of the presence of certain cardiac disease states.

Interpreting an ECG without proper correlation with the clinical situation is potentially misleading and should never be done. An ECG is an adjunct to clinical findings in diagnosis and should not supplant it.

Baseline ECG

A baseline ECG is useful in interpreting the subtle ECG changes that might represent an acute myocardial ischemia. About two thirds of all patients with a proven MI have the classic findings - new Q waves, ST segment elevation and deep T wave inversion; 10% of patients with MI have a normal ECG. The remainder have nonspecific findings which could represent myocardial ischemia. An ECG is helpful in interpreting these subtle findings.

The absence of ECG changes does not rule out an acute myocardial infarction.

A baseline ECG does not influence a decision on hospital admission. Baseline ECG must be made available to the physician on short notice and must have been done recently enough (within 6 months). Current evidence does not justify performing a resting ECG in men without evidence of cardiovascular disease or risk factors for coronary artery disease.*(Ann. Int. Med. 111;6; 489 - 501)*

Diagnostic Categories In Which The ECG Is Useful

Essential	Important	May be useful
Arrythmias	Chamber enlargement	Electrolyte disturbances
Pacemaker funtion	Myocardial infarction	Congenital heart disease
Conduction disturbances	Myocardial ischemia	Muscular dystrophies
	Pericardial disease	Cor pulmonale
		Pulmonary embolism
		Hypothermnia
		Myxedema
		Drug effects *

** Antiarrhythmics, digitalis, antineoplastic agents, phenothiazines, antidepresants, antiparasitic compounds.*

ECG As A Screening Test

The Canadian Task Force on The Periodic Health Examination recommends against doing a resting ECG as part of a comprehensive health evaluation. There are some ECG findings which increase the probability of an apparently healthy person dying from coronary artery disease. However these findings are uncommon and the risk of death attributable to them is too small to recommend screening for their presence.

The ECG does not provide a diagnosis. An electrocardiographic 'label' for a certain pattern does not in reality represent a diagnosis but a statement that a cardiac abnormality correlates best with a given ECG pattern. Thus, the presence of an abnormal Q wave considered diagnostic for MI merely indicates that this change best correlates with a focal area of transmural necrosis or a scar. The same abnormality can be produced by hypertrophic obstructive cardiomyopathy, by an unusual form of pre-excitation or even a rare normal variant (hence the importance of a clinical correlation vide above.) Thus each ECG pattern has its own sensitivity, specificity and predictive accuracy.

There is no evidence to suggest that a resting ECG as a screening test for CHD is useful in men without evidence of cardiovascular disease or risk factors for coronary artery disease *(Ann. Int. Med. 111;6;489-501).*

However the American Heart Association recommends routine ECGs in asymptomatic persons at the ages of 20, 40 and 60. (Vide chapter on screening for cardiovascular disease).

Recommendations For The Use Of The ECG

- An ECG is not routinely indicated before noncardiac surgery or on general hospital admission.
- An ECG may be useful in:
  a) Patients with history or physical findings suggestive of heart disease.
  b) There is no evidence to suggest that a resting ECG is useful in men without evidence of cardiovascular disease or risk factors for coronary artery disease.
  c) Patients with systemic disease associated with clinically important but previously unrecognised cardiac abnormalities (hypertension, atherosclerotic peripheral vascular disease, diabetes mellitus, collagen vascular disease or certain malignancies).
  d) Patients concurrently taking noncardiac medications with cardiac toxicity (Phenothiazines, tricyclic antidepressants, doxyrubicin and related drugs).
  e) Patients at risk for major electrolyte abnormalities.
  f) Patients having elective intrathoracic, intraperitoneal, aortic surgeries or major neurosurgery.

18 OFFICE SCREENING

Screening For Cardiovascular Disease

Blood Pressure

Identifying Those At Risk

Those under the age of forty with pressures in the high normal range (130 - 140mm Hg systolic and 85 -89 mm Hg diastolic) should be viewed as being at risk of hypertension especially if they are overweight or sedentary.

BLOOD PRESSURE

Follow Up After Initial Blood Pressure Measurements In Adults

	Range	Follow Up
Diastolic pressure	< 85	Recheck within two years
	85 - 89	Recheck within one year
	90 -104	Confirm within two months
	105 -114	Evaluate and initiate care promptly. (within two weeks)
	> 115	Evaluate and initiate care immediately
Systolic pressure.	< 140	Recheck within two years
(When diastolic	140 - 199	Confirm within two months
is less than 90)	> 200	Evaluate and initiate care promptly (within two months)

Blood pressure monitoring during exercise is an excellent means of identifying persons likely to be eventually hypertensive at rest. The diastolic pressure normally does not increase with exercise; The physiologic response is no change or even a slight decrease. An increase in diastolic pressure to levels greater than 100 mm Hg during exercise is especially predictive. A reasonable approach to patients with borderline or labile hypertension would be to record BP during and immediately after 30 seconds of stair climbing or an equivalent activity.

The Framingham Heart Study has shown that left ventricular hypertrophy is a strong predictor of cardiovascular disease events and echocardiography (not ECG) may prove to be a means of identifying hypertensive patients at a high risk of a complicating event (congestive heart failure, transient ischemic attacks, strokes).

Lipoprotein Levels

The National Cholesterol Education Program has determined that serum cholesterol levels should be measured in all patients, beginning at the age of 20 and routinely repeated at least once every five years. The work up and recommendations are summarized in the algorithm below.

Guidelines

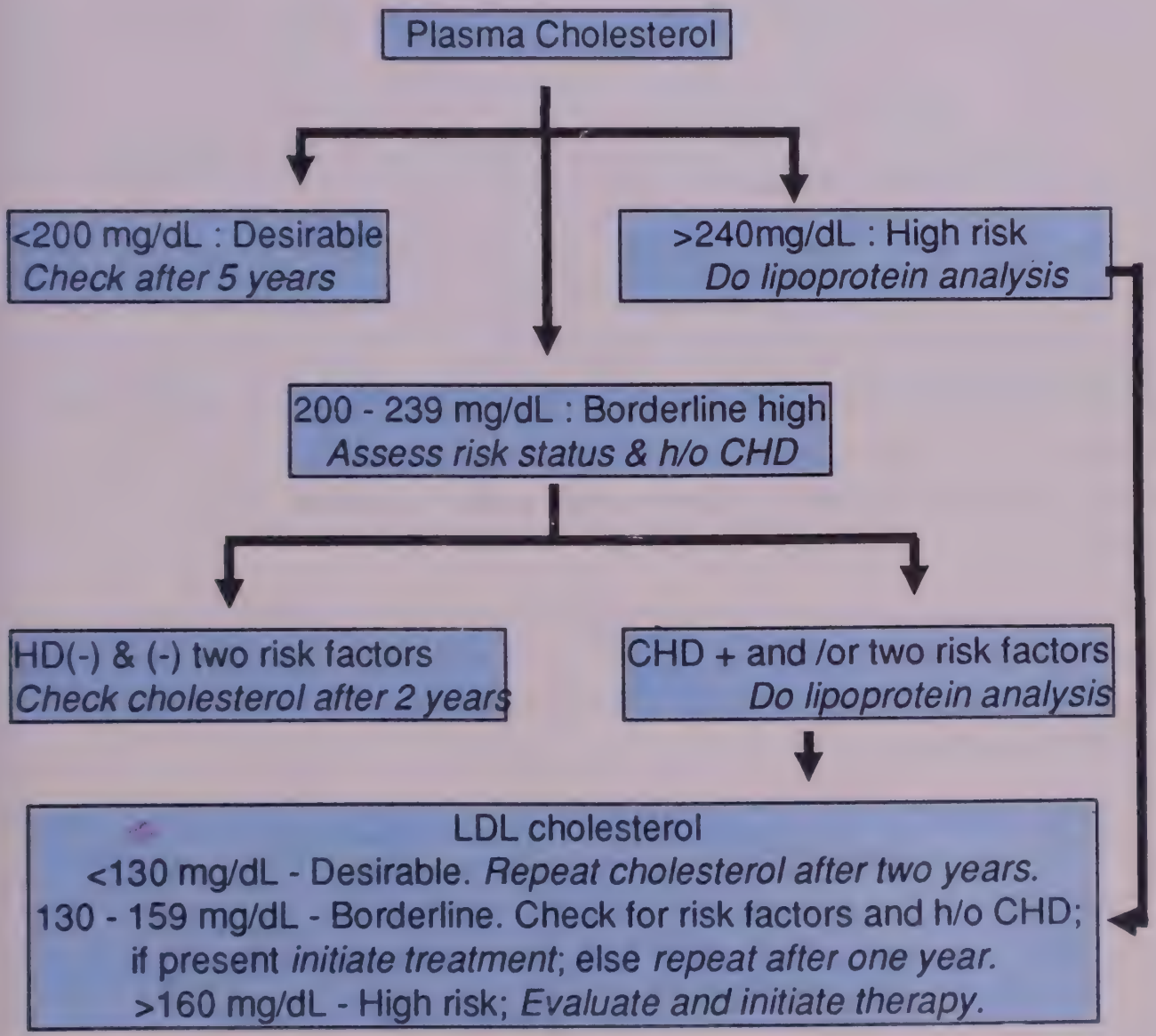
a. The values should be the average of two to three measurements taken one to eight weeks apart.

b. Patients do not have to fast before a blood sample is taken for total cholesterol levels.

c. Risk factors for cholesterol used in evaluation of total cholesterol and LDL cholesterol include:

1. Male sex.
2. Family history of premature coronary heart disease (CHD). (definite MI or sudden death before age 55 in a parent or a sibling).
3. Cigarette smoking.
4. Low HDL cholesterol concentration (< 35mg/dl).

5. Diabetes mellitus.
6. Hypertension.
7. Presence of cerebrovascular or peripheral artery disease.
8. Severe obesity (more than 30% overweight).
9. Family history of hyperlipidemias.
10. Ischemic heart disease.



d. Lipoprotein analysis requires that the patient fast 14 hours before the sample is taken. The total cholesterol, HDL cholesterol and triglycerides are measured. LDL cholesterol is calculated using the formula

Total cholesterol - HDL cholesterol - (triglycerides / 5)

e. Therapy should be aimed at achieving a LDL cholesterol level of less than 160 mg / dl. (130 mg /dl in high risk patients). Drug therapy should be considered if dietary therapy is ineffective.

f. Total serum cholesterol levels are generally sufficient in judging the efficacy of intervention with lipoprotein evaluation required only periodically.

Chest X-Ray and ECG

The American Heart Association recommends

1. A baseline chest film at forty and none there after unless clinically indicated. Chest films on a regular basis may be justified for smokers and hypertensive patients.

2. Routine ECGs are recommended at ages 20, 40, and 60. Patients with symptoms and signs suggestive of heart disease warrant more frequent electrocardiography as do patients at significant risk of heart disease. (Vide above.)

3. Exercise testing and ambulatory monitoring of the asymptomatic patient is not recommended. Exercise testing of the asymptomatic patient should be reserved for those at elevated risk and those over forty who plan to engage in vigorous exercise.

SUMMARY

Screening The Asymptomatic (nonsmoking) Adult For Cardiovascular Disease.

- BP every two years
- Weight every four years
- Serum cholesterol every five years.
- X- ray once at forty.
- ECG every twenty years

II

Anti microbial therapy

1 ANTIMICROBIAL THERAPY

Empirical Initial Therapy On Diagnosis

This chapter provides for starting therapy on clinical grounds. Remember, optimal antimicrobial therapy is based on accurate identification of causative oraganism and in vitro suspectibilty testing.

Note. Drugs listed are representative of the class (for eg. methicillin represents penicillinase resistant semisynthetic penicillins). Drugs of the same class may be substituted unless otherwise specified.

Diagnosis	Situation	Etiology	Primary	Secondary	Comment
1. Bone					
Osteomyelitis	Newborn infant	S.aureus Enterobacteriae Streptococci A&B	Cloxacillin + Cefotaxime		Often associated with contiguous joint invovement
	Child <3 yrs	H.influenzae. Streptococcus.	Cefuroxime or Cefotaxime		
	Child >3yrs and adults	S.aureus	Cloxacillin	Cephalexin or	*Do not use in pregnant women

Diagnosis	Situation	Etiology	Primary	Secondary	Comment
Osteomyelitis				Ciprofloxacin* + Rifampin	or in children
2. Central nervous system					
Meningitis	Infant <3months	Group B &D Streptococcus* Enterobacte-riaceae, Listeria*	Ampicillin + gentamicin or Cefotaxime	Amikacin if resistant to to gentamicin	Monitor drug lev-elsof gentamicin *Cefotaxime not effective, base dec-. ision on gram stain.
	1-3 months	H.influenzae Pneumococci Meningococci Streptococci(B)	Ampicillin + Cefotaxime		
	3months -10 years	H. influenzae # Pneumcocci Meningococci	Cefuroxime or Cefotaxime	Ampicillin + Chloramphenicol	#Give rifampin prophylaxis after therapy
	Adult	Meningococci Pneumococci Listeria	Penicillin G (high doses)	Ampicillin or Chloramphenicol	

Diagnosis	Situation	Etiology	Primary	Secondary	Comment
3. Ear					
a. External Otitis	Chronic	Secondary to Seborrhoea	Eardrops: PolymyxinB + Neomycin + Hydrocortisone		Control of seborrhoea
	Diabetes Mellitus acute "malignant" Otitis Externa	Pseudomonas	Carbenicillin or Ciprofloxacin		Surgical drainage; exclude associated osteomyelitis.
b.Furuncle of external canal	No associated cellulitis	S. aureus	none		Incision & drainage
	Associated cellulitis		Cloxacillin	Cephalexin or Amoxicillin clavunalate	Incision & drainage
c. Otitismedia					
Acute, with effusion	Infants < 3months	Pneumococci H.influenzae B.catarrhalis S.aureus	Ampicillin + Gentamicin		Oral: if patient is afebrile,stable & asymptomatic Parenteral: fever

Diagnosis	Situation	Etiology	Primary	Secondary	Comment
Otitis, Acute		Streptococcus(A&B) sterile,Enterobacter			no improvement in 48 hours; Tymapanocentesis LP if sepsis.
	Infants >3months, children & adults.	Pneumococci H.influenzae B.catarrhalis S.aureus Streptococcus.(A) sterile.	<4years: Erythromycin + Sulfonamide >4years: Erythromycin + Cotrimoxazole* or Cefuroxime		Tympanocentesis may hasten resol ution. * not effective against Group A Streptococci.
Chronic	Includes recurrent and prolonged episodes of acute.	same as acute	same as acute		

Diagnosis	Situation	Etiology	Primary	Secondary	Comment
d. Mastoiditis					
Acute		Pneumococci H.influenzae B.catrarhalis	Cefuroxime or Cefotaxime or Amoxicillin-clavunalate	Cotrimoxazole	Surgery.
Chronic Mastoiditis		Multiple.			Surgery . Base therapy on culture & sensitivity. *Empirical therapy not indicated.*
4.Endothelium					
a.Thrombophlebitis. (septic)	associated with venous catheters septic.	S.aureus S.epidermidis Enterobacteriae Candida Pseudomonas	Vancomycin + Cefotaxime		Remove catheter& culture with roll method. > 15 colonies favour infection. Surgical removal or ligation usually indicated.

Diagnosis	Situation	Etiology	Primary	Secondary	Comment
5. Eye					
a.Blepharitis		S.aureus	Erythromycin or Chloramphenicol ointment to lid margins		If associated with lid abscess as suggested by presence of preauricular node, use systemic carbenicillin.
b. Conjunctivitis		Adenovirus H.influenzae Pneumococcus Streptococcus(A)	Neomycin, Polymyxin (topical)	Sulfacetamide	Give topical antibiotics as drops every 1-2 hours during waking hours & as ointment 1-2 times in the night.
c. Stye (Hordeolum)		S. aureus	None		Hot soaks, I&D; Antibiotics (carbenicillin only if preauricular lymphadenopathy or cellulitis; Topical antibiotics to lids are not of value.
d. Dacryocystitis		Pneumococci Streptococci S.aureus	PenicillinG or Carbenicillin		*Base choice of antibiotic on gram stain.

Empirical initial therapy

Diagnosis	Situation	Etiology	Primary	Secondary	Comment
Dacryocystitis		Pseudomonas	or Gentamicin*		I&D only if pointing
6.Gastrointestinal System.					
a. Typhoidal syndrome		Salmonella Typhi;and other species	Chloramphen-icol *(po) or Ciprofloxacin	Ampicillin or Cotrimoxazole	*otherdrugs If resistan t to chloramphenicol
b. Perirectal abscess		Enterobacteriae Bacteroides Enterococcus	Cefotaxime or Amoxicillin -Clavunalate		Surgical drainage is primary; Consider under-lying regional enteritis
7. Genital Tract					
a. Septic abortion		Bacteroides Streptococus(B) Enterobacteriae-	Clindamycin or Metronidazole + Gentamicin		D & C . In septic abortion Clostridium perfri-ngens may cause fatal disseminated intravascular coagulation.
b.Endomyo metritis	Early post partum period (-48 h)	Bacteroides Streptococcus(B) Enterobacteriae	See septic abortion		Usually after caesarean section.

Diagnosis	Situation	Etiology	Primary	Secondary	Comment
Endomyo metritis	Late post partum period (48 h -6 weeks)	Chlamydia trachomatis	Tetracycline*	Erythromycin	*2gm po qd for 10 days. Discontinue breast feeding Usually after vaginal delivery
c. Epididymo orchitis	age <35 yrs	Gonococcus Chlamydia trachomatis	Treat for gonorr-hoea, then, Doxycycline 100mg po bid x 7 days		Expressible ureth-ral discharge and inguinal pain usually present.
	age >35yrs	Enterobacteriae	Cotrimoxazole	Ampicillin Sulfonamides Tetracyclines	Midstream pyuria & scrotal edema usually present
d.Gonorrhoea		Gonococcus	Cefotaxime* + Doxycyline.@ or Ciprofloxacin$	Ampicillin + Tertracycline.#	*single dose 250mg IM. @ 0.1g bid & #0.5g qid PO x 7 days. $0.75 mg PO bid x 7 days.
e. Post gonoccal or non gonococal urethritis		Chlamydia ureaplasma	Doxycycline or Ciprofloxacin	Erythromycin	

Diagnosis	Situation	Etiology	Primary	Secondary	Comment
f. Syphilis	Early; primary secondary latent <1yr	T.pallidum	Benzathine penicillinG 2.4 million units IM	Tetracycline 500 mg qid x 15 days or Erythromycin 500 mg po qid x 15 days	Document allergy before choosing alternative. Quantitative VDRL at 3, 6, and 12 months after therapy. VDRL titre should decrease 4 fold at 3 months, 8 fold at 6 months Retreat if 1) Clinical signs recur 2) sustained 4 fold increase in titre occurs. 3) A initial high titre fails to fall to less than 1:8 in 1 year.
	More than 1 years duration		Benzathine penicillin 2.4 million units IM every week for 3 weeks (total 7.2 million units)	Tetracycline 500 mg q6h po for 30 days or Erythromycin 500 mg q6h for 30 days	No published data on efficacy of alternatives

Diagnosis	Situation	Etiology	Primary	Secondary	Comment
Syphilis	Neuro syphilis		PenicillinG	Chloramphenicol	Aqueous penicillin G 10 million units / /day for 10 days followed by Benzathine penicillin 2.4 mega units IM weekly for 3 weeks
	Pregnancy		As for the non gravid	Erythromycin*	Monthly quantitative VDRL; If 4 fold increase retreat * Infants of mothers treated with erythromycin should be treated with penicillin
	Congenital		Aqueous crystalline PenicillinG		50000 U/kg IM q12h for 10 days.
g.Chancroid		H.ducreyi	Erythromycin[@]	Cotrimoxazole[#] or Ciprofloxacin[$]	@ 0.5mg q6h /7d # po q12h/ 7 d $ 0.5g q12h / 7 d
h. Lymphogranuloma venerum		Chlamydia trachomatis	Doxycyline[#]	Erythromycin[@] /chloramphenicol	# 0.1g q12h / 21 d @ 0.5g q6h/ 21 d

Diagnosis	Situation	Etiology	Primary	Secondary	Comment
i. Vaginitis	Pruritus thick disharge	Candida	Miconazole	Nystatin	Avoid intercourse for 3-4 days
	Copious foamy disharge	Trichomonas vaginalis	Metronidazole 2g single dose	20% saline douche in first trimester	Treat male sexual partners
8.Lung					
a.Abscess	Aspiration	Bacteroides Peptostreptococcus Fusobacterium	Clindamycin	Pencillin G	Bronchoscopy to rule out neoplasm Metronidzole not as effective.
b. Bronchitis Acute	Age < /=5 years	Respiratory syncitial or parainfluenza virus	None		
	Adolescent & adult	Viral			
	No infiltrate in Xray	Mycoplasma	Not indicated		
	Infiltrate in Xray	Chlamydia	Erythromycin	Tetracycline	
Chronic	Smokers	Pneumococi H.influenzae B.catarrhalis viral	Amoxycillin-Clavunalate Cotrimoxazole Doxycyline		Stop smoking.
c.**Pertussis**		Bordetella pertussis	Erythromycin		

Diagnosis	Situation	Etiology	Primary	Secondary	Comment
d.Pneumonia (community acquried)	Lobar: no underlying emphysema or fibrosis	Pneumococci Strptococcus (A)	Penicillin G or Amoxycillin	Erythromycin and if severely ill Cephazoline Cotrimoxazole	
	Lobar: Underlying emphysema or fibrosis	above + H.influenzae Klebsiella Coliforms	Penicillin + Tobramycin or Cefuroxime or Cefotaxime		
	Atypical	Pneumococci Mycoplasma Legionella Chlamydia	Erythromycin	Tetracycline	
9. Mouth					
Vincent's angina		Fusospirochetes	PenicillinG	Tetracycline Erythromycin	Avoid ampicillin
10. Muscle					
Gas gangrene	Contaminated wound	C.perfringens	PenicillinG	Tetracycline Chloramphenicol	Surgical debridement; hyperbaric oxygen.

Diagnosis	Situation	Etiology	Primary	Secondary	Comment
11. Peritoneum					
a.Peritonitis	Nephrotic/cirrhotic	Pneumococci Streptococus (A) Enterobacteriae S.aureus		Ampicillin	
	Bowel perforation	Enterobacteriae Entrococi Bacteroides		Cefotaxime	Add metronidazole if antibiotics were used previously.
12. Pharynx					
a. Exudative pharyngitis		Streptococcus (A) Viral Infectious mononu cleosis.	Benzathine pencillin G, IM	Erythromycin	
b.Laryngitis		Viral	Not indicated.		
13. Sinuses					
a. Acute sinusitis		Pneumococus H.influenzae Streptococus (A) Anerobes Viruses	Ampicillin	Cotrimoxazole	
b. **Chronic sinusitis**		Bacteroides Peptostreptococcus Fusobacterium	Clindamycin or amoxicilln clavunalate-	Penicillin G	

Diagnosis	Situation	Etiology	Primary	Secondary	Comment
14. Skin					
a. Decubitus ulcers		S.aureus Streptococcus (A) Anaerobes	Clindamycin + Gentamicin	Cephalexin + Methicillin	Surgical debridement; Topical silver sulfadiazine
b. Impetigo	Non-bullous	Streptococcus (A) S.aureus	Penicillin V	Erythromycin	
	Bullous	S.aureus	Erythromycin	Cephalexin	
15. Systemic syndromes.					
a. Brucellois	Adult	Brucella species	Doxycyline + Rifampin*	Cotrimoxazole + Gentamicin	Duration 3 weeks Gentamicin only for 5 days *Use gentamicin in children
b.**Leptospirosis**		Leptospira	Doxycyline or Pencillin G		Effective if started within 4 days of onset.
c. Sepsis	Adult non immuno compromised	Enterobacter S aureus Streptococcus A &D Pneumococci Bacteroides	Ceftazidine + Clindamycin (or metronidazole)		**Criteria for sepsis:** fever > 38.3°C tachycardia >90/min tachpnoea >20/min + 1 manifestation of organ dysfunction. High dose steroids *are not* beneficial

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2 PROPHYLACTIC USE OF ANTIBIOTICS

Common Indications And Recommendations For Their Use In Medicine*

Indication	Drug(s)	Dose&Duration	Comments
1. Bite wounds	Amoxicillin + clavunalate	for 3-5 days	
	Penicillin V	500 mg tid for 3-5 days	
2. Influenza	Amantadine	100 mg bid for 4-6 weeks	Decrease to once daily if patient is elderly or has renal insufficiency.
3. Meningococcal meningitis	Rifampicin	20 mg /kg bid for two days	For all household contacts except pregnant women
4. Ophthalmia neonatorum	Topical silver nitrate. Topical tetracycline		
5. Plague	Streptomycin	1g/ day for one week	
	Tetracycline	30mg /kg /day in 4 divided doses for 10days	
6. Recurrent cellultis in lymphedema	Benzathine penicillin	0.6 to 1.2 million units once a month	Indicated only if patient is having recurrent cellulitis.

Indication	Drug(s)	Dose&Duration	Comments
Recurrent cellulitis	Penicillin V	250 --500 mg qid for 1 week	
7. **Recurrent cystitis**	Cotrimoxazole	40 + 200mg at bedtime	
	Trimethoprim	100mg at bedtime	
8. Rheumatic fever	Benzathine penicillin	1.2 million units every month life long	
	Penicillin G	200 000 units orally two times a day life long	
9. Sexually transmitted diseases			Treat partner with appropriate drug
10. Tuberculosis	Isoniazid	300mg /day for 1 yr.	Monthly follow up for toxicity

* *excluding bacterial endocarditis.*

3

PROPHYLACTIC ANTIBIOTICS

Their use in surgical practice

Vigneshwar Kasirajan, (M.S.)

The Data Base

Definition. Prophylactic antibiotics refers to the administration of antibiotic agents to patients without evidence of established infection, with the objective of reducing subsequent postoperative septic complications.

Prophylactic antibiotics are indicated only in *clean contaminated wounds* and *clean wounds in which foreign material is implanted* (vascular grafts, heart valves, artificial joints etc.). See table 1

Timing

The antibiotic should be given within one hour of commencement of the operation.(*Most surgeons prefer to administer them one hour prior to incision or at the time of induction of anesthesia - editors*)
Continue only for 24 hrs after surgery (if necessary) and never more than that.

If oral drugs are used (as in colon preparation), use only for 24 hrs before surgery.Longer use of antimicrobials leads to growth of resistant organisms.

Route Of Administration

The intravenous route in a relatively small volume of diluent, over a short period, is preferrable.

Use of the same doses as continuous IV infusion or intermittent IM is not effective.

Oral administration (of nonabsorbable antibiotics) is used only for colon preparation.

Choice of antibiotics.

This depends on a knowledge of the nature of the offending microflora and the expected antibiotic sensitivities of these micro-organisms.

Type	Definition	Infecting organism	Wound infection rate	Prophylactic antibiotics
Clean wound	The gastrointestinal or bronchial tree is not entered eg. inguinal hernia repair, breast surgery, thyroidectomy,	Aerobic gram + bacteria - (exogenous). S. aureus, S.epidermidis Streptococci.	<2%	None except when prosthetic material is implanted as in vascular grafts, heart valves, artificial joints.
Clean - contaminated	Elective operation in which gastrointestinal tract or bronchial tree has been entered eg. elective colorectal surgery.	Endogenous micro flora of transected organ usually gram - aerobic baciili such as E. coli, and anaerobes such as bacteroides fragilis	5-10%	Yes
Contaminated	Acute inflammation (without pus formation or gross spillage of GI contents) as encountered at surgery.	Endogenous micro flora of transected or inflammed organ	about 20%	No prophylaxis Use antibiotics for treatment

Type	Definition	Infecting organism	Wound infection rate	Prophylactic antibiotics
Dirty	Gross pus at surgery usually due to organ perforation.	Endogenous micro flora	about 40%	No prophylaxis Use antibiotics for treatment.

Clinical correlations

The following surgeries require antibiotic prophylaxis:

Type of operation	Choice of antibiotic and dose	Timing before surgery	Route
Head and neck Anticipation of cutting cross a contaminated area (nose, sinuses,mouth) or entering duramater (during ethmoidectomy)	Cefazolin 1 g	30 min	IV
Neurosurgery. Presence of devitalised bone, or large area of dead space is expected Insertion of ventricular shunts.	Cefazolin 1g	30 min	IV

Type of operation	Choice of antibiotic and dose	Timing before surgery	Route
Thoracic. Perforation or transection of esophagus or bronchial tree. Penetrating chestwall injury with extensive soft tissue injury.	Cefazolin 1g	30 min	IV
Cardiac and vascular Placement of grafts prosthetic conduits valves and cardiopulmonary bypass.	Cefazolin 1g or Cefoxitin 1g	30 min	IV
Abdominal operations. Gastrectomy, pyloro-piasty in the presence of obstruction (duodenal ulcer or malignancy) or achlorhydria.	Cefazolin 1g	30 min	IV
Enterotomy in presence of obstruction, blind loop syndrome.	Cefoxitin 1g or Gentamycin 80 mg with metronidazole 500 mg.	30 min	IV
Biliary procedures in high risk* patient	Gentamycin 80 mg or Cefazolin 1g	30 min	IV

(- includes age >70 yr, CBD stones,obstructive jaundice,previous biliary operation,operation as an emergency,chills or fever within 1 wk of operation, operation done within 1 month of acute cholecystitis.*

Type of operation	Choice of antibiotic and dose	Timing before surgery	Route
Colon or rectal (with 3 day mechanical bowel	Neomycin 1g erythromycin base 1g	8 hrly for 24 hrs before surgery	Oral
	Cefoxitin 1g or gentamycin 80 mg with metronidazole 500 mg.	30 min	IV
Penetrating abdominal wounds or vascular accidents	Cefoxitin 1g or gentamycin 80 mg with metronidazole 500 mg.	30 min	IV
Pelvic operations Hysterectomy, cesarean section after rupture of membranes.	Cefazolin 1g	30 min	IV
Urologic surgery with obstructed urinary tract	Gentamycin 80 mg or Cefoxitin 1g.	30 min	IV
Orthopedic surgery implantation of prosthesis, foreign materia etc.l.	Cefazolin 1g	30 min	IV

Prophylactic antibiotics are of no value in clean operative precedures like hernia repair, thyroidectomy, breast surgery etc. The use of antibiotic prophylaxis in the patient who undergoes a clean surgical procedure in the presence of decreased host resistance (metabolic derangements, agammaglobulinemia, corticosteroid or immunosuppressive therapy) is not indicated. This is because commonly used prophylactic antibiotics do not cover the relatively rare and dissimilar organisms that cause infection in this clinical setting.

4

THERAPY OF TUBERCULOSIS

Guidelines

Category	Circumstance	Therapy	Regimen
1. **Exposure** (Tuberculin negative)	Neonate	Essential	INH 10 mg/kg/day for 3 months. If tuberculin positive and/or chest xray abnormal after 3 months add rifampin. Total duration of treatment - 6 months.
	Children under 5 yrs	Indicated	INH as above for 3 months. If tuberculin positive after 3 months continue INH for another 3 months
	Adults	Not indicated	Repeat tuberculin at 3 months if positive, treat for 6 months.
2. Infection without disease (Tuberculin positive)	All ages	Indicated	INH (max 300 mg/day) for 6 months (6 months treatment as effective as older 12 month therapy).
3. Active disease	Pulmonary	Essential	6 month regimen. INH + rifampin + pyrizinamide for 2 months. After 2 months INH + rifampin daily. Add ethambutol if resistance is likely.

Category	Circumstance	Therapy	Regimen
Active disease	Extra-pulmonary	Essential	Regimen as above atleast for 9 months. Longer regimens for bone and joint disease and lymphadenitis.
	Pregnancy	Essential	INH + rifampin + ethambutol. Pyrizinamide contraindicated. Not an indication for therapeutic abortion.

III

Drug Profiles & Usage

Acetaminophen

INDICATIONS & DOSE

Common indications: Fever, pain (for symptomatic relief), arthritis.

Route : PO *; Dose* :-325-650 mg q 4-6h

Pediatric Use : *Dose*: 10-15 mg/kg, q 4-6hrs.

ADVERSE REACTIONS

Common: Hepatic damage (plasma levels 200 mcg/ml at 4hr following overdose).

Occasional: Panytopenia, meth&sulthemoglobinemia, hemolytic anemia & cyanosis

Rare But Serious : Skin reactions, hypoglycemia, CNS stimulation, renal tubular necrosis.

PREGNANCY & LACTATION

Pregnancy: Safe.
Lactation: Safe.

Precautions : Use with caution in-patients with G 6 PD deficiency.

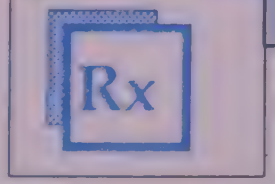
Patient Instructions Physician consult must in children under three or if in use for more than ten days.

Pharmacology: Analgesic and antipyretic similar to aspirin, weak anti-inflammatory action.

Available As: 250 and 500 mg tablets

Consumption of acute large doses or chronic use leads to depletion of glutathione and may cause hepatic necrosis.

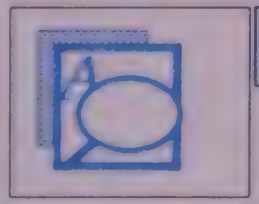
Alpha methyl dopa



INDICATIONS & DOSE

Hypertension :- *Route:* PO ;
Dose: 250mg ,q 8-12 hrs initially, increased every few days to a maximum of 2-3gms/day.
Hypertensive emergencies:- *Route* IV;
Dose: 250-500 mg q 6hrs to a maximum of 1g q 6 h.

Paediatric Use 10mg/kg/day in 2-4 divided doses, initially to a maximum of 65mg/kg/day or 3 g whichever is less



ADVERSE REACTIONS

Common :Weight gain, drowsiness, dizziness, nasal congestion.
Occasional: Depression, diarrhoea, orthostatic hypotension.
Rare But Serious : hepatitis, hemolytic anemia.

PREGNANCY & LACTATION

Pregnancy : Safe..
Lactation:: Use with caution.

CONTRAINDICATIONS

Active hepatic disease & known liver dysfunction with previous M dopa therapy.

Parameters To Monitor : Obtain baseline CBC, LFT & direct Coomb's test. Periodic CBC & LFT recommended.

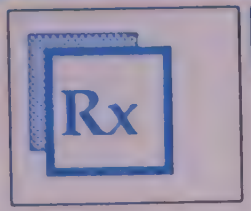
Precautions : Use with caution in hepatic disease .

Patient Instructions : Report appetite loss, jaundice, mood changes, arthralgias and unexplained fevers. Avoid cough, cold & allergy medications except on advice by a physician.

Interference With Laboratory Tests
1. Interferes with estimation of urinary uric acid & SGOT. 2. Causes false elevations of urinary catecholamines 3. Positive direct Coomb's test may occur.

Pharmacology: It acts by central stimulation of alpha2 adrenergic receptors.
Available As : 250 mg & 125 mg tablet

Ampicillin



INDICATIONS & DOSE

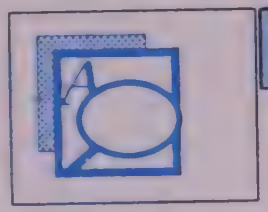
Mild infections:- *Route:* PO;
Dose: 250-500 mg, q 6 hrs.

Moderately severe:- *Route:* IM/IV;
Dose: 250-500 mg, q 6 hrs.

Severe (meningitis):- *Route:* IM/IV;
Dose: 150-200mg/kg/day in 6-8 divided doses.

Other Indications:- Respiratory, skin, gastrointestinal & genito urinary infections, bacterial meningitis, prevention of bacterial endocarditis and septicemia.

Paediatric Use:. 50-100 mg/kg/day, PO/IV.



ADVERSE REACTIONS

Common: Skin rashes, nausea, diarrhoea.

Rare but serious: Interstitial nephritis, penicillin encephalopathy.

PREGNANCY & LACTATION

Pregnancy: Safe.

Lactation: Safe.

CONTRAINDICATIONS

H/O anaphylactic, accelerated or serum sickness reaction.

Precautions: Do not combine in vitro with aminoglycosides. Administer solution before an hour after preparation. May cause skin rashes in patients with infectious mononucleois.

Pharmacology : bactericidal, predominantly gram positive coverage.

Available As: Cap 250, 500mg; inj 500mg.

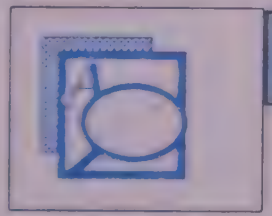
Antacids

INDICATIONS & DOSE

Acid Peptic disease:- *Route:* PO; *Dose:* 100-160 meq acid neutralizing capacity per dose 1 & 3 hrs after meals & hs for 4-8 weeks.

Other Indications:- Symptomatic relief of gastro-esophageal reflux, peptic ulcer disease, prevention of stress related mucosal bleeding and phosphate binding in renal failure.

Pediatric Use: 5-15 ml as often as q 1hr.



ADVERSE REACTIONS

Common: Milk alkali syndrome (rebound acid secretion, metabolic alkalosis, hypercalcemia).

Occasional: Constipation, hypophosphotemia.

Rare but serious: Encephalopathy in patients on dialysis.

PREGNANCY & LACTATION

Pregnancy: Safe.

Lactation: Safe.

Parameters To Monitor: Observe for diarrhea, constipation, relief of epigastric pain. Serum magnesium & phosphate levels

Precautions: Use with caution in patients with hypertension, CCF, edema, renal impairment.

Patient Instructions: Avoid other oral drugs within 1-2 hrs of antacid therapy.

Chew tablet thoroughly before swallowing.

Pharmacology: Neutralizes gastric acid; aluminium antacids decrease serum phosphate by binding to phosphates in GI tract.

Liquid antacids are better than tablets.

Aspirin

INDICATIONS & DOSE

Fever and minor pain:- *Route:* PO;
Dose: 325-975mg, q4h g/d.

Rheumatoid arthritis:- *Route:* PO
Dose : 3-6g/d ,divided doses.

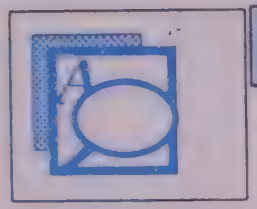
Acute rheumatic fever:- *Route:* PO;
Dose : 5-8g/d in 1g divided doses.

Other Indications:- Risk reduction in stroke, coronary artery disease, pregnancy induced hypertension and prevention of neointimal hyperplasia in vascular grafts.

Paediatric Use: Use of aspirin in children has been asscociated with Reye's syndrome. Not recommended for routine use in children under 14 years.

Juvenile rheumatoid arthritis:
Dose: 90-130mg/kg/d.

Acute rheumatic fever:
Dose: 100mg/kg/d then, 75mg/kg/d for 4-6weeks.

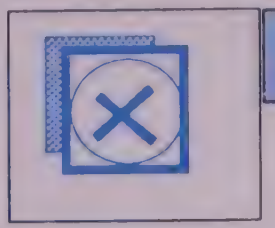


ADVERSE REACTIONS

GI upset, occult bleeding, hearing impairment, visual disturbances, hepatotoxicity.

PREGNANCY & LACTATION

Pregnancy: Unsafe (Low dose aspirin has now been shown to increase length of gestation, birth weight and decrease maternal morbidity and mortality,when given to pregnant women with high risk of developing pregnancy induced hypertension).
Lactation: Risk not known.



CONTRAINDICATIONS

Bleeding diathesis.

Parameters To Monitor: Watch for occult GI loss. Monitor levels with higher doses.

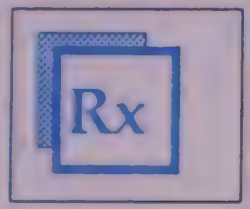
Precautions: Use with caution in gastric ulcer, bleeding diathesis & history of asthma.

Patient Instructions: Take with milk, food or water to minimise GI upset.

Pharmacology: Analgesic antipyretic and anti-inflammatory effect. Properties related to inhibition of prostaglandin synthesis. Irreversibly inhibits platelet aggregation

Available As: 300 mg tablets.

Atenolol

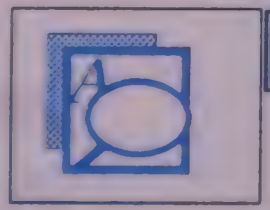


INDICATIONS & DOSE

Hypertension:- *Route:* PO;
Dose : 25mg - 100mg/day

Angina:- *Route:* PO; *Dose:* 50mg/day

Others indications:- Myocardial infarction.
Paediatric Use: Not recommended



ADVERSE REACTIONS

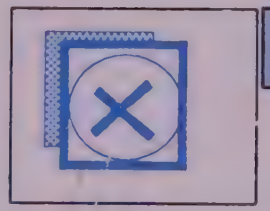
Common: Bradycardia, vertigo, diarrhoea, postural hypotension, edema.

Occasional: Fatigue, nausea, chest pain, urticaria, nightmares.

Rare but serious: CHF, AV block, bronchospasm.

PREGNANCY & LACTATION

Pregnancy: Avoid.
Lactation: Avoid.



CONTRAINDICATIONS

Sinus bradycardia, CHF, heart block, cardiogenic shock, anesthesia with ether.

Warnings: In angina, avoid abrupt discontinuation. The drug may mask signs of hyperthyroidism.

Precautions: Do not combine with other beta blockers. Use with caution in hypoglycemia. Reduce dose in impaired renal function.

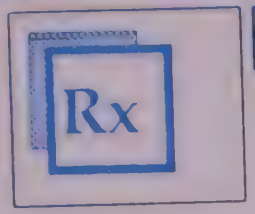
Patient Instructions: Refer class instructions for hypotensive agents.

Laboratory interferences: May produce false negative glucose tolerance test.

Pharmacology: Cardioselective beta (B1) receptor blocke

Available as: 50, 100 mg tablets

Atropine



INDICATIONS & DOSE

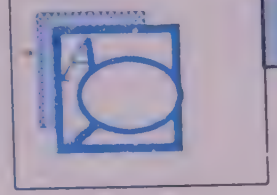
Gastro intestinal uses:- *Route:* PO; *Dose:* 400-600 mcg, q 6h.

Preanesthetic medication:- *Route:* SC/IM/IV; *Dose:* 300-600 mcg, before induction.

Bronchodilator:- *Route:* Inh; *Dose :* 0.025-0.05 mg/kg, q 6h.

Other indications:- Poisoning with cholinergic drugs, peptic ulcer, GI hypermotility and spastic disorders, Parkinsonism, vagally mediated bradyarrhythmias.

Paediatric Use. PO; 10 mcg/kg, q 6h; Inh; 0.05-0.075 mg/kg.



ADVERSE REACTIONS

Common: Xerostomia, bradycardia, inhibition of sweating & fever.

Occasional: Palpitation, mydriasis, blurring of near vision, hot dry skin, acceleration of the heart preceded by slowing in higher doses.

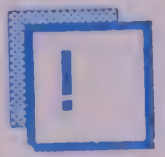
PREGNANCY & LACTATION

Pregnancy. Avoid .

Lactation. Avoid.

CONTRAINDICATIONS

Acute angle glaucoma, posterior synechiae, obstructive disease of GI & urinary tract, hiatal hernia with reflux, unstable cardiovascular status, tachycardia, myasthenia gravis.



Parameters To Monitor: Size of pupil.

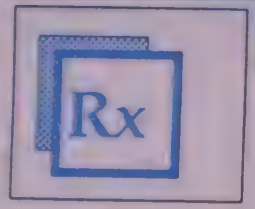
Warnings: May cause heat stroke due to lack of sweating.

Precautions: Use with caution in patients over 40 yrs with other known medical diseases.

Patient Instructions: Take 30 mins before meals. Caution while driving and other tasks requiring mental alertness. Avoid concurrent excessive use of alcohol or other drugs causing drowsiness. May cause dryness of mouth & constipation.

Pharmacology: Competitive antagonist of acetylcholine at peripheral muscarinic and central receptors.

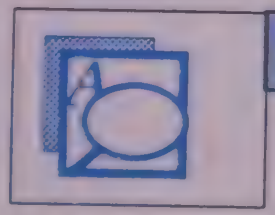
Bisacodyl



INDICATIONS & DOSE

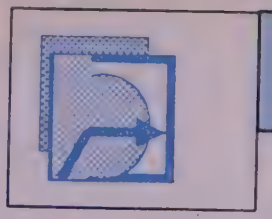
Laxative & cathartic:- *Route:* PO; *Dose:* 5-20 mg

Paediatric Use. PO; 5-10mg (6yrs), PR 5mg(yrs), PR 10mg (2yrs).



ADVERSE REACTIONS

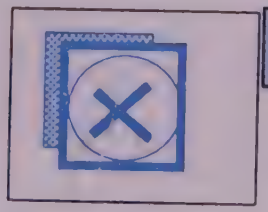
Abdominal cramps, rectal irritation in suppositories.



PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation.: Use with caution.



CONTRAINDICATIONS

Acute abdomen, fecal impaction, intestinal or biliary tract obstruction, abdominal pain of unknown origin, acute hepatitis, intestinal perforation.

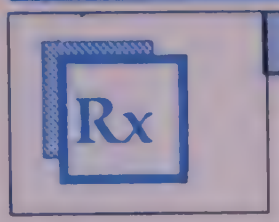
Patient Instructions: Tablets should be swallowed, not chewed or crushed. Do not take within 1hr of antacids or dairy products.

Pharmacology: A stimulant cathartic which acts by direct contact with colonic mucosa. Net water and electrolyte absorption may also be inhibited.

Available As: Tablets 5mg; suppositories 10mg.

Chronic use of cathartics is not recommended.

Carbenicillin

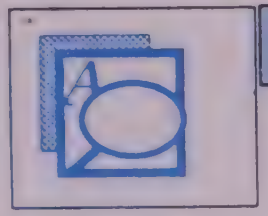


INDICATIONS & DOSE

Genito-urinary, acute & chronic respiratory infections, septicemia, skin & soft tissue infections.

Route: IV/IM; *Dose:* 2-4g, q 4-6 hrs

Paediatric Use: 50-200 mg/kg/day, q 4-6 hrs



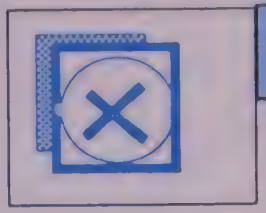
ADVERSE REACTIONS

May cause bleeding episodes due to inhibition of platelet aggregation and hypokalemia.

PREGNANCY & LACTATION

Pregnancy: Safe.

Lactation: Safe.



CONTRAINDICATIONS

Hypersensitivity.

Precautions: Inject into upper outer quadrant of the buttock. Carbenicillin should not be mixed with gentamicin or tobramycin in vitro because of gradual inactivation of the latter. The therapeutic effects of these drugs are unimpaired when administered separately. Inject the drug very slowly

Pharmacology: Broad spectrum, bactericidal, primarily indicated for infections due to Pseudomonas and Proteus.

Available As: 1g injections for IM/IV use.

Carbidopa/Levodopa

INDICATIONS & DOSE

Parkinson's disease:- *Route:* PO; *Dose:* 10 mg for 100mg of Levodopa.

Paediatric Use: Not safe.

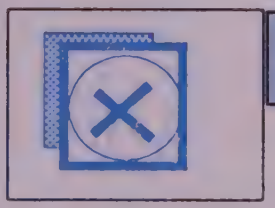
ADVERSE REACTIONS

See levodopa.

PREGNANCY & LACTATION

Pregnancy: Avoid.

Lactation: Avoid.



CONTRAINDICATIONS

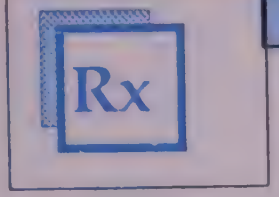
Known hypersensitivity to Levodopa.

Precautions: Discontinue levodopa at-least 8 hours before starting carbidopa/ levodopa.

Pharmacology: Carbidopa inhibits extracerebral DOPA decarboxylase, prevents peripheral decarboxylation of levodopa, increasing the amount available to the brain & allows a 75% reduction in the amount of levodopa needed for therapy.

Available as: 10mg Carbidopa/100mg Levodopa; 25 mg Carbidopa, 100mg Levodopa.

Cefotaxime

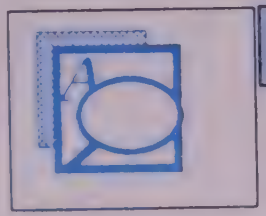


INDICATIONS & DOSE

Nosocomial & postoperative infection, gonorrhea (single 1 gm IM injection).

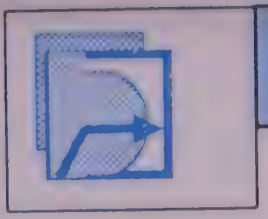
Route: IM/IV; *Dose:* 1-2 gms, q 8-12 hrs.

Paediatric Use: 50-180 mg/kg/day, q 6 hrs.



ADVERSE REACTIONS

Hypersensitivity, antabuse like reaction, bleeding tendencies.



PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation: Use with caution.

CONTRAINDICATIONS

Hypersensitivity.

Parameters To Monitor: Prothrombin time, renal function tests.

Warnings: Do not mix with aminoglycosides in vitro.

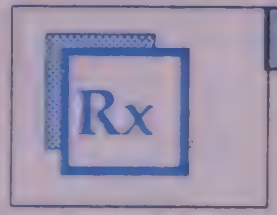
Precautions: Penicillin allergy. Use with caution in renal impairment, bleeding diathesis & critical illness.

Interference With Laboratory Tests: False positive direct Coombs test & urine glucose.

Pharmacology: 3rd generation, broad spectrum, bactericidal.

Available As: 1, 2, 10 g injections for IV use.

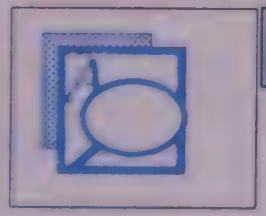
Cefazolin



INDICATIONS & DOSE

Surgical prophylaxis:- *Route:* IM/IV; *Dose:* 1g, 30-60 mins prior to surgery.

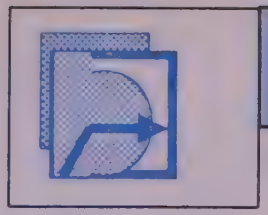
Paediatric Use: 25-50 mg/kg/day, q 6-8 hrs.



ADVERSE REACTIONS

Occasional: Allergic reactions, neurotoxicity.

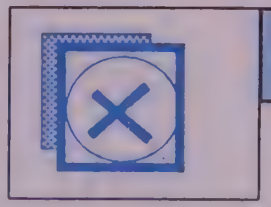
Rare But Serious: Coagulopathy.



PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation: Use with caution.



CONTRAINDICATIONS

Hypersensitivity.

Parameters To Monitor: Renal function tests.

Precautions: Use with caution in allergic reaction, renal impairment.

Pharmacology: Bactericidal, broad spectrum.

Available As: 250, 500 mg & 1 g injections.

Chloramphenicol

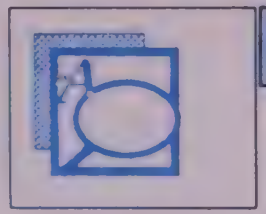
INDICATIONS & DOSE

Absolute: Typhoid, paratyphoid.

Other indications : UTI, meningitis (H influenzae), plague, trachoma, lymphogranuloma venereum, brucellosis.

Route: PO; *Dose:* 50-100 mg/kg, q 6 hrs

Paediatric Use: Use with caution.
Dose: 50-75 mg/kg, PO or IV in divided doses.



ADVERSE REACTIONS

Common: Reversible bone marrow depression.

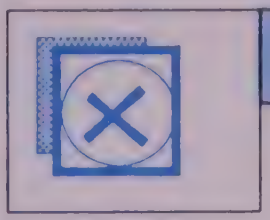
Occasional: Aplastic anemia, paroxysmal nocturnal haemoglobinuria, GI disturbances and hypersensitivity.

Rare But Serious: Gray baby syndrome

PREGNANCY & LACTATION

Pregnancy: Avoid.

Lactation: Avoid.



CONTRAINDICATIONS

Prophylactic use, trivial infections (others than those indicated).

Parameters To Monitor: Complete blood count, serum iron, liver & renal function tests.

Precautions: Liver disease, previous hemotological disorders, G6PD deficiency.

Patient Instructions: Take on empty stomach. Report sore throat, fever or oral lesions.

Pharmacology: Broad spectrum bacteriostatic.

Available As: 250, 500 mg capsule. 100 mg/mL injection.

Chloroquine

INDICATIONS & DOSE

Malaria:- *Route:* PO; *Dose:* 1g initially, 500mg 6hrs later; 500 mg on three successive days.

Amoebiasis (Extraintestinal):-
Route: PO; *Dose:* 1g/day for 2 days, 500mg/day for 2-3 weeks.

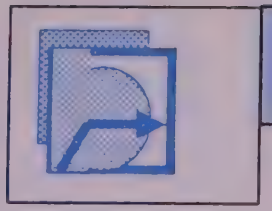
Paediatric Use: *Route:* PO;
Dose: 10mg/kg initially; 5 mg/kg after six hours; 5mg/kg /day for two days.

ADVERSE REACTIONS

Common: Intolerance, retinopathy, loss of accomodation.

Occasional: Seizures, T wave inversion in the ECG, psychotic episodes.

Rare But Serious: Neuromyopathy, blood dyscrasias, nerve deafness, hemolysis.



PREGNANCY & LACTATION

Pregnancy: Safety not established.

Lactation: Safety not established.

CONTRAINDICATIONS

Presence of retinal or visual field changes, hypersensitivity.

Parameters To Monitor: Regular ophthalmic checkup.

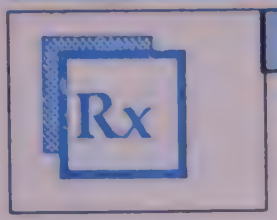
Precautions: Use with caution in G6PD deficiency.

Patient Instructions: Take with food, report visual & GI disturbances, difficulty in hearing of ringing in the ears. Complete full course of therapy.

Pharmacology: It fixes protozoal DNA in a double strand with a hydrogen bond, so that it is unable to replicate or serve for the transcription of RNA. Protein synthesis is thus decreased through ribosomal destruction.

Available As: (sulphate, phoshphate) 150 and 250 mg tablets.

Chlorpheniramine



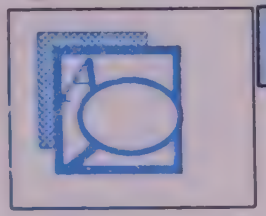
INDICATIONS & DOSE

Acute allergy:- *Route:* PO; *Dose:* 12mg in 1-2 divided doses.

Anaphylaxis:- *Route:* IM/IV; *Dose:* 10-20 mg upto 40 mg/day.

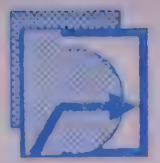
Allergy to blood/plasma:- *Route:* IM/IV; *Dose:* 10-20 mg/day.

Paediatric Use: 0.35 mg/kg/day



ADVERSE REACTIONS

Drowsiness, drymouth, dizziness & irritability.



PREGNANCY & LACTATION

Pregnancy: Avoid.

Lactation: Avoid.

CONTRAINDICATIONS

Lactation, premature and newborn infants.

Precautions: Use with caution in the elderly. Do not use in asthma, glaucoma or symptomatic prostatic hypertrophy except under physician supervision.

Patient Instructions: Avoid frequent use.

Pharmacology: A competitve antagonist of histamine at the H1 receptor. Also has anticholinergic and transient sedative effects when used intermittently.

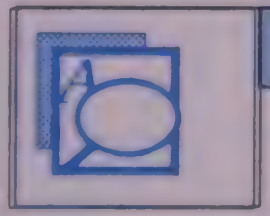
Available As: Sustained release 8 and 12 mg capsules; syrup 2mg/5mL; tablets 4mg injection 10mg/mL (IM, IV, SC).

Chlorpromazine

INDICATIONS & DOSE

Antipsychotic:- *Route:* IM/PO; *Dose:* 25 mg/ 25-50 mg, q 8hrs.
Antiemetic:- *Route:* PO/IM; *Dose:* 10-25 mg/ 25-50 mg, q 4-6hrs.
Hiccoughs:- *Route:* PO/IM; *Dose:* 25-50 mg, q 6hrs.
Others:-Manic depressive disorders, nausea & vomiting, behavioral problems in children, adjunct in the treatment of tetanus. Acute intermittent prophyria, restlessness and apprehension prior to surgery. Anxiety, tension and agitation in neuroses.

Paediatric Use: Not recommended in children under 12yrs. *Route:* PO/IM; *Dose:* 0.5 mg/Kg, q 4-6 h.



ADVERSE REACTIONS

Common: Agranulocytosis, hypotension, pseudoparkinsonism, photosensitivity.

Occasional: Tardive dyskinesia, heart failure, jaundice.

PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation: Secreted in milk. Safety not established.

CONTRAINDICATIONS

Avoid in epileptics & during myelography.

Patient Instructions: Avoid alcohol and other depressants, exposure to sunlight; Caution during driving. May discolour urine pink.

Interference With Laboratory Tests: An increase in cephalin flocculation and alteration in other liver function tests. Discolors urine pink to red-brown. The drug may cause false positive pregnancy tests. An increase in protein bound iodine not attributable to increase in thyroxine has been demonstrated .

Pharmacology: Antipsychotic, antiemetic.

Available As: 10mg, 25mg, 50mg, 100mg tablets; injection 25mg/ml;syrup 25mg/5mL

Dapsone

INDICATIONS & DOSE

Leprosy:- *Route:* PO; *Dose:* 50-100 mg/day, continue use in lepra reaction.

Paediatric Use: Same as adult dose.

ADVERSE REACTIONS

Common: Dose related hemolysis, phototoxicity, GI distress.
Occasional: Peripheral neuropathy, albuminuria, nephrotic syndrome.

PREGNANCY & LACTATION

Pregnancy: Use with care.

Lactation: Avoid.

CONTRAINDICATIONS

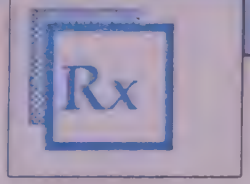
Hypersensitivity.

Precautions: Use with caution in hepatic and renal diseases and in G6PD deficiency.

Pharmacology: Bactericidal & bacteriostatic to M. leprae.

Available As: Tablets 25, 100 mg.

Dexamethasone



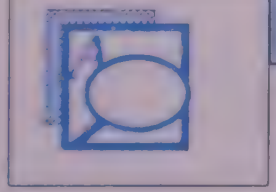
INDICATIONS & DOSE

Acute exacerbation of allergic disorders:- *Route:* PO; *Dose:* 0.75-10 mg/day in 2-4 divided doses initially, tapered over 7 days and discontinued.

Cerebral edema:- *Route:* IV; *Dose:* 10 mg initially, followed by 4 mg, q 6h, tapered over 5-7 days and discontinued. (No consensus over usefulness in therapy.)

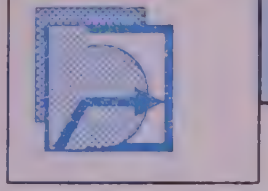
Other Indications:- As antiemetic in cancer therapy and as a suppression test to screen for Cushing's disease (PO).

Paediatric Use: 0.024-0.34 mg/kg/day, q 6 hrs.



ADVERSE REACTIONS

Prolonged therapy leads to suppression of pituitary - adrenal function. Rapid withdrawal causes adrenal crisis. Long term use of this drug (which is not indicated) can cause the same adverse effects of prednisone. Perineal itching or burning can occur after IV administration.



PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation: Avoid breast feeding 2-4 hrs after a dose.

CONTRAINDICATIONS

Systemic fungal infections.

Parameters To Monitor: Observe for psychotic personality changes, signs and symptoms of Cushing's syndrome, serum potassium and glucose, blood pressure, stool for occult blood, periodic eye exam

Precautions: Use with caution in diabetes, osteoporosis, acid peptic disease, chronic granulomatous and other infectious disease, hypertension and other CVS diseases.

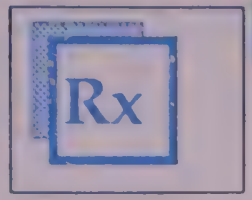
Patient Instructions: Take with milk, food or antacid; do not discontinue without medical approval.

Interference With Laboratory Tests: Suppresses TB skin test reactions.

Pharmacology: A potent, long acting glucocorticoid, lacking sodium retaining activity.

Available As: Injection 4 mg/ml, tablets 0.25 mg upwards.

Diazepam



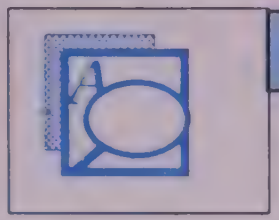
INDICATIONS & DOSE

Anxiolytic:- *Route:* PO; *Dose:* 10 mg hs.

Alcohol withdrawal:- *Route:* PO; *Dose:* 5-20 mgs qid.

Anticonvulsant:- *Route:* IV; *Dose:* 10 mg stat then 5mg at 15 mins intervals.

Paediatric Use: 1-2.5 mg qid. Most benzodiazepines are not recommended in children due to insufficient clinical experience.



ADVERSE REACTIONS

Common: Drowsiness, dizziness, ataxia, disorientation.

Occasional: Agitation 'paradoxical rage reaction', hypotension & respiratory depression.

Rare But Serious: Hepatic disease & blood dyscrasias.

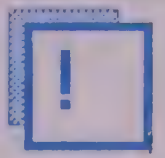
PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation: Avoid.

CONTRAINDICATIONS

Acute narrow angle glaucoma.



Warnings: Abrupt drug withdrawal may result in rebound insomnia, seizures or psychosis.

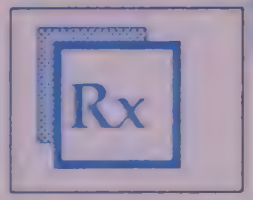
Precautions: Pregnancy, impaired hepatic function.

Patient Instructions: Use caution while driving and operating machinery. Avoid concurrent use of alcohol.

Pharmacology: Anxiolytic, sedative, muscle relaxant & anticonvulsant, facilitate GABA mediated transmission and mimic the actions of glycine at its receptor sites.

Available As: 5 mg tablets and injection 5 mg/mL Note. Benzodiazepines are preferred to other agents in alcohol withdrawal.

Digitalis

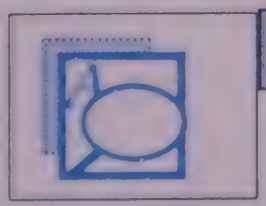


INDICATIONS & DOSE

Congestive heart failure:- *Route:* PO; *Dose:* 0.5mg loading dose; maintenance 0.25mg/d.

Other Indications:- Left ventricular failure, to control ventricular rate in atrial fibrillation and atrial flutter ;paroxysmal atrial tachycardias(PAT), AV nodal PAT.

Paediatric Use: Loading dose 0.5mg; maintenance 0.1mg/d.

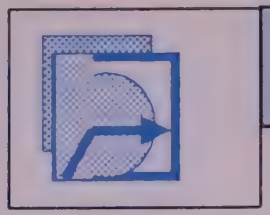


ADVERSE REACTIONS

Common: Arrhythmias-PAT with block, venricular fibrillation, ventricular tachycardias-heart block, anorexia, vomiting, visual defects.

Occasional: Vertigo, headache, diarrhoea.

Rare But Serious: Psychotic behaviour, aphasia, delirium.



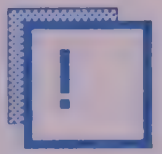
PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation: Safe.

CONTRAINDICATIONS

Hypertrophic obstructive cardiomyopathy, digitalis toxicity, heart block(2 or 3degree).



Parameters To Monitor: Heart rate, ECG, symptoms of toxicity BUN and creatinine, serum electrolytes especially potassium. Obtain plasma digoxin levels only when toxicity is suspected.

Warnings: Hypokalemia predisposing to digitalis toxicity. May increase infarct size in the non failing heart.

Precautions: Use with caution in pulmonary disease.

Patient Instructions: Report visual disturbances, GI distress, tiredness, appetite loss.

Pharmacology : Positively inotropic, antiarrhythmic action due to increase in AV nodal refractory period with a moderate direct vasoconstrictor action.

Available As: 0.25mg tablets, injection .5mg/2 mL.

Diphenoxylate

INDICATIONS & DOSE

Usually available in combination with atropine sulfate (Lomotil).

Diarrhea:- Route: PO; Dose:1-2 tabs, q 6 hrs.

Paediatric Use: Avoid under 2yrs. Use liquid only. PO 4 ml q 6-8 hrs.

ADVERSE REACTIONS

Occasional: Drowsiness, dizziness & headache.

Rare But Serious: Dry mouth, blurred vision, fever or tachycardia.

PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation: Use with caution.

CONTRAINDICATIONS

Children under 2 yrs, advanced liver disease.

Parameters To Monitor: Frequency and volume of bowel movements, observe for signs of atropine toxicity.

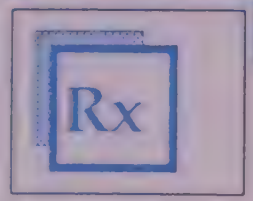
Warnings: May cause blurred vision, drowsiness or dizziness.

Precautions: Use with caution in chidren due to variable response and potential for toxicity, and in patients with acute ulcerative colitis or cirrhosis.

Pharmacology: Diphenoxylate is a narcotic like agent that slows GI motility atropine is added in subtherapeutic amounts to decrease abuse potential.

Available As: Tablet & syrup: 2.5 mg diphenoxylate with 25 mcg atropine per 5 mL in syrup.

Dipyridamole

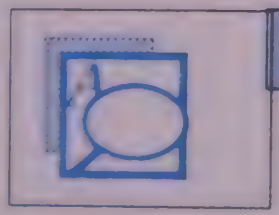


INDICATIONS & DOSE

Angina:- *Route:* PO; *Dose:* 50-100 mg, q 8 hrs.

Other Indications: Prevention of myocardial reinfarction,dynamic imaging of the heart.

Paediatric Use:. Avoid



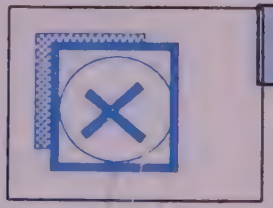
ADVERSE REACTIONS

Common: Headache, dizziness, GI disturbance, flushing, weakness, syncope & skin rash.

Rare But Serious: Aggravation of angina.

PREGNANCY & LACTATION

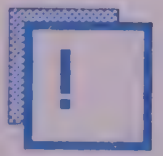
Pregnancy: Safety not established



CONTRAINDICATIONS

Lactation: Avoid.

Bleeding diathesis



Precautions: Use carefully in hypotension (excessive use produces peripheral vasodilatation).

Patient Instructions: Take 1hr before meals with plenty of water.

Pharmacology: Inhibition of platelet aggregation & selective coronary artery dilatation.

Available As: Tab 25, 50, 100 mg.

Dopamine

INDICATIONS & DOSE

Cardiogenic shock:- *Route:* IV infusion; *Dose:* 2-5 mcg/kg/min, upto 20-50 mcg/kg/min, increase in 5-10 mcg increments.

Refractory CCF:- *Route:* IV infusion; *Dose:* 0.5-1mcg/kg/min initially to an optimum of 1-3 mcg/kg/min.

Other Indication:- Hypotension.

Paediatric Use: Not established.

ADVERSE REACTIONS

Common: Ventricular arrhythmias, Hypertension at high infusion.

Occasional: Nausea, vomiting, angina pectoris.

Rare But Serious: Gangrene of extremities.

PREGNANCY & LACTATION

Pregnancy: Safe.

CONTRAINDICATIONS

Lactation: Safe.

Pheochromocytoma, presence of uncorrected tachyarrhythmias or ventricular fibrillation.

Parameters To Monitor: In shock closely monitor heart rate, pulmonary capillary wedge pressure, cardiac index, arterial blood pressure, arterial blood gases, acid-base balance, toe temperature, urine output, signs of vasoconstriction or extravasation (eg. blanching).

Precautions: Correct hypovolemia before using dopamine in shock. Use with caution in patients with occlusive vascular disease. Avoid extravasation. Extreme caution in patients recieving halogenated hydrocarbon anaesthesia.

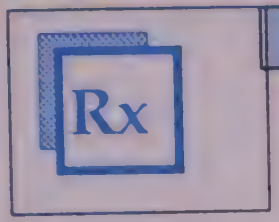
Pharmacology: It acts on dopaminergic, B1 & Aadrenergic receptors. It acts indirectly acts by releasing norepinephrine from sympathetic nerve storage sites.

Available As: Injection 40, 80, 160 mg/mL.

Dopamine dilution guide

Amount added mg	volume	Volume of diluent	Final concentration
200	5ml (1amp-40mg/mL)	250 mL	800 mcg/mL
200	5ml (1amp-40mg/mL)	500 mL	400 mcg/mL
400	5mL (1amp-80mg/mL)	500mL	800 mcg/mL
800	10mL (1amp-160mg/mL)	500mL	1600 mcg/mL

Erythromycin



INDICATIONS & DOSE

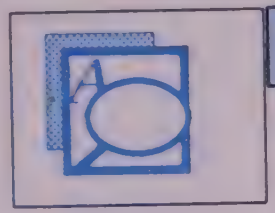
Absolute:- Diphtheria, pertusis, respiratory infection.

Common:- Prophylaxis against bacterial endocarditis, Legionnaires disease, skin infections, intestinal amoebiasis, Chlamydia.

Rare:- T pallidum & elective colorectal surgery.

Route: PO; *Dose:* 250-500 mg, q 6hrs.

Paediatric Use: 30-50 mg/kg/day in 4 divided doses.



ADVERSE REACTIONS

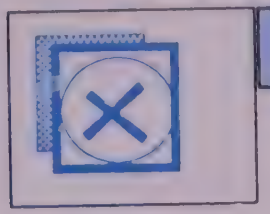
Common: GI disturbances, phlebitis, malaise, nausea.

Rare But Serious: Reversible intrahepatic cholestatic hepatitis,transient tinnitus and deafness.

PREGNANCY & LACTATION

Pregnancy: Avoid.

Lactation: Avoid.



CONTRAINDICATIONS

Hypersensitivity, hepatic dysfunction.

Parameters To Monitor: Liver function test.

Precautions: Use with caution in liver disease.

Patient Instructions: Take on empty stomach for optimum absorption.

Pharmacology: Acts against gram +ve organism, also active against Mycoplasma pneumoniae and Legionella pneumonphila. Gram +ve organisms develop resistance via R factor. Gram -ve are resistance due to cell wall impermeability.

Available as: Tablet 125, 250, 500 mg.

Furosemide

Parameters To Monitor: Serum electrolytes (especially potassium), glucose, BUN, uric acid, creatinine.

Precautions: Use with caution in renal & liver disease, diabetes or gout, in patients allergic to sulphonamides.

Patient Instructions: Potassium supplements, report dizziness, cramps, thirst or low urine output.

Pharmacology: Loop diuretic. Inhibits active chloride transport in the ascending limb of loop of Henle, thus increasing chloride and its attendant water and sodium excretion. IV doses increase venous capacitance independent of its diuretic effect producing rapid improvement in pulmonary edema.

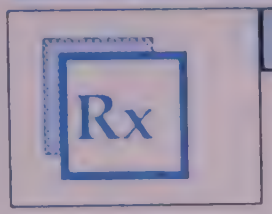
Available As: Tablets 20, 40, 80 mg; injections 10 mg/mL.

Note: IV should be used only when oral administration is not feasible. Rate of administration should not exceed 4 mg/min when large doses are given in patients with renal failure.

Total body potassium is not depleted during long term use in essential hypertension with or without renal disease. Potassium supplementation is not warranted. Thiazides are more effective in treatment of hypertension than furosemide.

Furosemide is light sensitive, Do not use injection if solution is yellow

Gentamicin



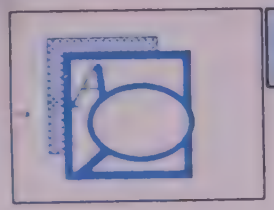
INDICATIONS & DOSE

Neonatal sepsis, septicemia, meningitis, peritonitis and other gram negative infections, severe staphylococcus infection when penicillins are contraindicated.

Route: IM/IV; *Dose:* 5-6 mg/kg/day, q 8 hrs.

Route: IT*; *Dose:* 4-8mg, q 18-24 hrs.

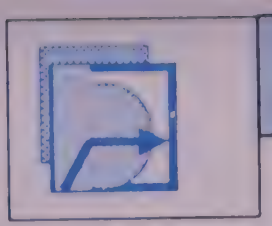
Paediatric Use: 5-7.5 mg/kg/day q 6-8 hrs.



ADVERSE REACTIONS

Common: Nephrotoxicity.

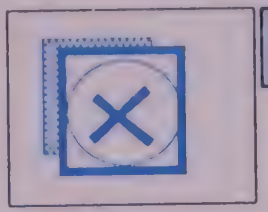
Occasional: Cochlear and vestibular damage, photosensitivity.



PREGNANCY & LACTATION

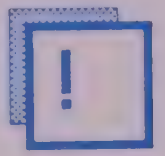
Pregnancy: Avoid.

Lactation: Use with caution.



CONTRAINDICATIONS

Hypersensitivity and conditions requiring long term antimicrobial therapy.



Parameters To Monitor: Renal function tests before and every 2-3 days during therapy, auditory and vestibular impairment.

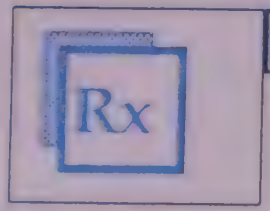
Precautions: Pre existing renal and vestibular impairment, hypocalcemia, myasthenia gravis and postoperative or other conditions which depress neuromuscular transmission.

Pharmacology: Gram -ve infections. Bactericidal. Anaerobic infections are resistant.

Available As: Inj 10, 40 mg/mL. IT inj 2 mg/mL. Opth ointment & solution 3mg/g and 3mg/mL.

** IT - Intrathecal*

Heparin



INDICATIONS & DOSE

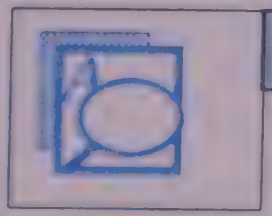
Thrombophlebitis:- *Route: IV; Dose:* 50-100 U/Kg loading, 10-15 U/Kg/hr.

Pulmonary embolism:- *Route:* IV; *Dose:* 50-100 U/Kg loading, 25U /Kg/hr.

Prophylaxis for deep vein thrombosis:- *Route:* SC; *Dose:* 5000 U 2hrs before surgery, repeat q 8-12 hrs till patient is ambulatory.

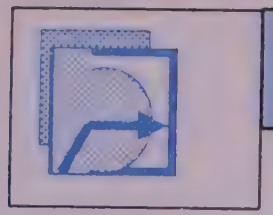
Other indications:- Embolic stroke, atrial fibrillation with embolisation, as an adjunct in treatment of acute MI and prevention of clotting in arterial and cardiac surgery.

Paediatric Use: Same as adult in units/kg.



ADVERSE REACTIONS

Common: Hemorrhage, thrombocytopenia.
Rare But Serious: Osteoporosis, suppression or renal function, vasospastic reactions.



PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation: Safe.

CONTRAINDICATIONS

Active bleeding, thrombocytopenia, threatened abortion, SABE suspected intracranial hemorrhage, regional or lumbar block anaesthesia,severe hypotension, after eye, brain or spinal cord surgery.

Heparin

Parameters To Monitor: Bleeding time, clotting time, partial thromboplastin time 3-4 times on day one and once daily thereafter, platelet count and hematocrit every other day. Signs of bleeding daily.

Precautions: Avoid in trauma, malignancy, old women, recent surgery and acid peptic disease, IM injections and in congenital or acquired hemostatic disorders.

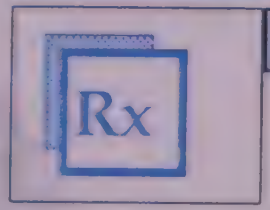
Patient Instructions: Consult the physician when considering the use of other drugs such as aspirin.

Interference With Laboratory Tests: Elevates SGOT, SGPT

Pharmacology: Binding with antithrombin III, neutralizes activated forms of factors XII, XI, IX, X, VII, II.

Available As: Inj 1000, 2500, 5000, 7500, 10,000, 15,000, 20,000, 40,000 units/mL.

Hydrochlorthiazide



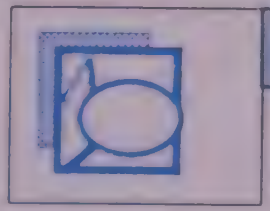
INDICATIONS & DOSE

Edema:- *Route:* PO; *Dose:* 25-200mg/day in 1-3 doses initially, then 25-100 mg/day maintanence.

Hypertension:- *Route:* PO; *Dose:* 12.5-50mg bd upto 200mg/day.

Other Indications:- Reduce frequency of renal stone formation.

Paediatric Use: Under 6 mths upto 3.3 mg/kg/day in 2 doses, above 6 myhs 2.2mg/kg/day in 2 doses.

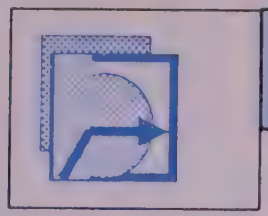


ADVERSE REACTIONS

Common: Volume depletion, hypotension, weakness, hyperuricemia, hypokalemia, hypochloremic alkalosis.

Occasional: Hyperglycemia and precipitation of diabetes mellitus.

Rare But Serious: Thrombocytopenia, pancreatitis.



PREGNANCY & LACTATION

Pregnancy: Avoid.

Lactation: Avoid.

CONTRAINDICATIONS

Anuria, pregnancy, sulfonamide allergy.

Parameters To Monitor : Serum potassium weekly or monthly initially; then every 3-6 months when stable. Other electrolytes periodically especially when associated with vomiting and diarrhea. Clinical signs of fluid and electrolyte depletion.

Precautions: Use with caution in renal dysfunction, liver disease, diabetes, gout.

Patient Instructions: Take with food, report nausea, anorexia. If divided doses are taken, the last dose should be taken in the evening to avoid voiding of urine in night. Report when dizziness or lightheadedness, muscle cramps, weakness, lethargy, drymouth, thirst or low urine output occurs.

Pharmacology : decreases ECF fluid volume, increases Na+ &Cl- excretion

Available As :25, 50, 100 mg tablets.

Ibuprofen

INDICATIONS & DOSE

Mild to moderate pain:- *Route:* PO; *Dose:* 200-400mg, q 6h.

Rheumatoid & Osteo arthritis:- *Route:* PO; *Dose:* 400-800mg, q6-8h maximum of 3.2 gms/day.

Primary dysmenorrhoea:- *Route:* PO; *Dose:* 200-400 mg, q 4h.

Paediatric Use: Not recommended.

ADVERSE REACTIONS

Common: Gastric distress, occult blood loss, diarrhea, skin rash and vomiting.

Occasional: Elevation of liver enzymes, GI ulceration, hyperuricemia.

Rare But Serious: Reversible decreased visual acuity, changes in colour vision, fluid retention and slight rise in bleeding time. Lymphopenia, aseptic meningitis, aplastic anemia and agranulocytosis.

PREGNANCY & LACTATION

Pregnancy: Safety not established.

Lactation: Safety not established.

CONTRAINDICATIONS

Pregnancy, children 14 yr and under, syndrome of nasal polyps, angioedema and bronchospastic activity to aspirin or other NSAIDS.

Parameters To Monitor: Occult blood loss, visual disturbances, weight gain.

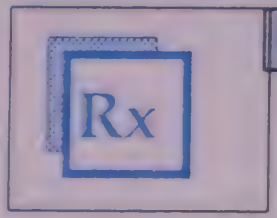
Precautions: Use with caution in patients with history of cardiac decompensation.

Patient Instructions: Take with small amount of food milk or antacid. Report any symptoms of GI ulceration, bleeding, eye symptoms, skin rash, weight gain or eczema. Dizziness may occur.

Pharmacology: Analgesic, antipyretic and antiinflammatory, properties, inhibits cycloxygenase and reversibly inhibits platelet function.

Available As: Tab 200, 300, 400, 500, 600 mg.

Indomethacin



INDICATIONS & DOSE

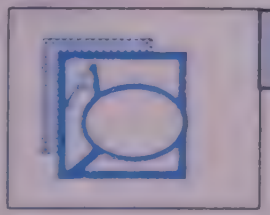
Rheumatoid arthritis:- *Route:* PO; *Dose:* 25mg, q 12h, increase in weekly increments of 25 mg/d maximum 150-200mg/d.

Route: PR; *Dose:* upto 100mg of daily dose.

Acute gouty arthritis:- *Route:* PO; *Dose:* 50 mg, q 8h.

Other Indications:- Closure of persistent ductus arteriosus in neonates.

Paediatric Use: Not recommended.

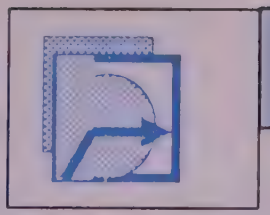


ADVERSE REACTIONS

Common: Frontal lobe headache, drowsiness, dizziness, mental confusion, GI distress.

Occasional: Peripheral neuropathy, occult bleeding, peptic ulcer.

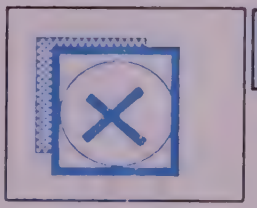
Rare But Serious: Provokes, asthma, angioedema, nasal polyps, pancreatitis, corneal opacities, hepatotoxicity, aplastic anemia, agranulocytosis; may aggravate psychiatric disorders, epilepsy and Parkinsonism.



PREGNANCY & LACTATION

Pregnancy: Safety not established.

Lactation: Safety not established.



CONTRAINDICATIONS

Pregnancy, lactation, children under 14, H/O recurrent or active GI lesions, syndrome of nasal polyps, angioedema, and bronchospastic reactivity to aspirin or other NSAIDS..

Indomethacin

Parameters To Monitor: Periodic ophthalmic exam and complete blood count during prolonged therapy.

Precautions: Stop drug if headache, corneal opacities and retinal disturbances persist; may mask signs and symptoms of infection. Use with great care in the elderly.

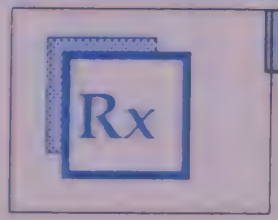
Patient Instructions: Take drug with food, milk, or antacid. Report any symptoms of GI bleeding or ulceration. Dizziness or headache may occur. Until the extent of these effects are known, use appropriate caution. Do not use aspirin unless directed otherwise.

Pharmacology: Analgesic and antipyretic; inhibits the cyclooxygenase pathway; reversibly alters platelet function and prolongs bleeding time.

Available As: Cap 25, 50 mg.

Note. Do not use as alternative to aspirin or in any condition other than those listed above.

Insulin (plain)



INDICATIONS & DOSE

Diabetes mellitus:- *Route:* SC;
Dose: must be adjusted in response to improvement of clinical symptoms and titrated to plasma glucose levels.

Diabetic ketoacidosis:- Route: IV/SC;

Paediatric Use: Yes.

ADVERSE REACTIONS

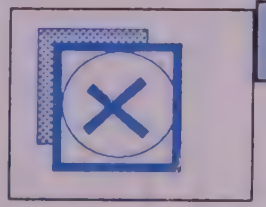
Common: Hypoglycemia, local allergic reactions (absent in human insulin).

Occasional: Lipodystrophy.

PREGNANCY & LACTATION

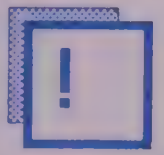
Pregnancy: Safe.

Lactation: Safe.



CONTRAINDICATIONS

Hypersensitivity.



Parameters To Monitor: Blood glucose, signs of lipodystrophy, subjective symptoms of hypo and hyperglycemia and allergic reactions.

Precautions: Use with caution in renal, hepatic disease & hypothyroidism.

Patient Instructions: Always use the same type and brand of syringe unit to avoid dosage errors.

Pharmacology: Promotes cellular uptake of glucose, fatty acids & amino acids.

Available As: Porcine, human and bovine insulin. Inj 40 units/mL. Note: Flush IV line with 50 mL of the insulin containing solution before adminstering as infusion. This saturates the adsorption sites in the catheter and reduces variability of response.

Isoniazid

INDICATIONS & DOSE

Tuberculosis:- *Route:* PO;
Dose: 5mg/Kg/day.

Tuberculous prophylaxis:- *Route:* PO;
Dose: 5mg/kg/day, to a maximum of 300 mg/day as a single agent for one year.

Paediatric Use: 10 - 15 mg/kg/day.

ADVERSE REACTIONS

Common: Peripheral neuropathy, nausea, allergy, subclinical hepatitis.

Occasional: Ataxia, muscular weakness, clinical hepatitis especially in the elderly.

Rare But Serious: CNS toxicity (with acute overdosage 6-10 g), massive liver atrophy.

PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation: Avoid.

CONTRAINDICATIONS

Acute or chronic liver disease, previous INH associated hepatitis

Parameters To Monitor: Signs of hepatitis & peripheral neuropathy, baseline and monthly AST & ALT in those over 35, alcoholics and patients with history of liver dysfunction.

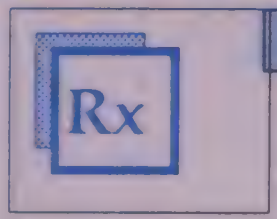
Precautions: Use with caution in alcoholics, elderly patients.

Patient Instructions: Report burning, tingling in extremities, dark urine, yellowing of eyes.

Pharmacology: Inhibits synthesis of mycolic acid, a component of the cell wall; tuberculostatic or tuberculocidal depending on the concentration achieved and rate of growth ofthe organism.

Available As: tab. 50, 100 and 300 mg.

Isosorbide dinitrate

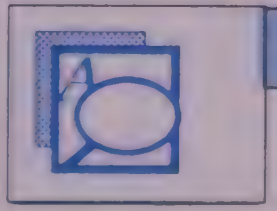


INDICATIONS & DOSE

Acute anginal attack:- *Route:* SL/PO; *Dose:* 2.5-10mg, q 2-3h, max 40mg.

Prophylaxis for angina and congestive heart failure:- *Route:* PO; *Dose:* 10-60mg, q 4-6hrs. max 120 mg.

Paediatric Use: Not recommended.

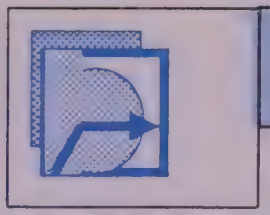


ADVERSE REACTIONS

Common: Headache, dizziness, palpitations, postural hypotension, GI distress.

Occasional: Skin reactions.

Rare But Serious: Tolerance & dependence.



PREGNANCY & LACTATION

Pregnancy: Safety not established.

Lactation: Safety not established.

CONTRAINDICATIONS

Severe anemia, postural hypotension, increased intracranial tension & idiosyncrasy.

Parameters To Monitor: Headache & other side effects; hemodynamic and measurements of cardiac function in CHF.

Precautions: In patients with renal, hepatic disease, low pulmonary wedge pressure states & concomitant use of hypotensive drugs.

Patient Instructions: Avoid concomitant use of alcohol. Do not discontinue drug abruptly except on advice of physician.

Pharmacology: Relaxes vascular smooth muscle, improves local myocardial blood supply; produces dose dependent dilatation of venous (predominantly) and arterial beds. Decreases myocardial oxygen consumption and increases mycardial perfusion.

Available as: Cap 40 mg; tab 5, 10 mg; SL tab 2.5, 5, 10 mg; sustained release tablets 20, 40 mg.

Levodopa

INDICATIONS & DOSE

Parkinson's disease:- *Route:* PO; *Dose:* 250mg, q 6-12 hrs increasing to 2-6g/day.

Paediatric Use: No.

ADVERSE REACTIONS

Common: GI distress, postural hypotension, adventitious movements, depression.

Occasional: Anxiety, insomnia, arrythmias.

Rare But Serious: Psychosis, agranulocytosis.

PREGNANCY & LACTATION

Pregnancy: Avoid.

Lactation: Avoid.

CONTRAINDICATIONS

Hypersensitivity, narrow angle glaucoma, h/o melanoma, patients on MAO inhibitor therapy.

Parameters To Monitor: CBC, renal & liver function tests and cardiovascular function. Monitor intraocular pressure in patients with glaucoma.

Precautions: Use with caution in patients with peptic ulcer, cardiovascular, renal, hepatic or endocrine disease.

Patient Instructions: Do not stop drug suddenly. Avoid foods or vitamins containing pyridoxine. Take with food. Caution while driving, Darkening of secretions may take place.

Interference With Laboratory Tests: Positive Coomb's test with prolonged therapy. Interferes with tests for urine ketones. Elevation of BUN,liver enzymes reported.

Pharmacology: Decarboxylated to dopamine in the basal ganglia.

Available As: Cap 100, 250, 500mg

Physician's Pocket Manual
02164
MP100
COMMUNITY HEALTH CELL
326, V Main, I Block 151
Koramangala
Bangalore-560034

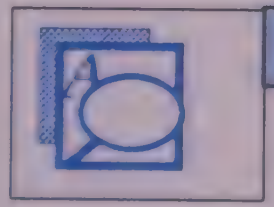
Lidocaine

INDICATIONS & DOSE

Ventricular arrhythmias:- *Route:* IV; *Dose:* 100mg over a minute. 2-4 mg/min.

Other Indications:- Local &spinal anaesthesia, ventricular tachycardia, post MI arrhythmia prophylaxis.

Paediatric Use: 1 mg/kg.

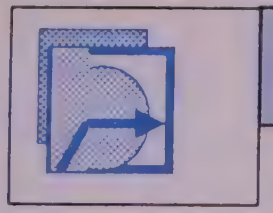


ADVERSE REACTIONS

Common: Vertigo, nausea, drowsiness, speech disturbances.

Occasional: Bradycardia, AV block.

Rare But Serious: Perioral numbness, muscle twitching & confusion.



PREGNANCY & LACTATION

Pregnancy: Avoid.

Lactation: Avoid.

CONTRAINDICATIONS

Hypersensitivity, heartblock, sinus node dysfunction, WPW syndrome.

Parameters To Monitor: ECG for toxic actions. Vital signs such as BP, heart rate and respiration.

Precautions: In patients with atrial fibrillation and accessory AV pathway

Patient Instructions: Report minor side effects sch as drowsiness, perioral numbness or tingling, dizziness or nausea during infusion.

Pharmacology: Increases fibrillation threshold, negative inotropic & anaesthetic.

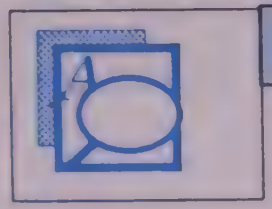
Available As: Inj 10, 20, 40, 100 mg/mL.

Loperamide

INDICATIONS & DOSE

Diarrhea:- *Route:* PO; *Dose:* 4mg initially, 2mg after each unformed stool upto 16 mg/day.

Paediatric Use: Avoid under 2yrs. 3-6 mg/day in divided doses.



ADVERSE REACTIONS

Occasional: Abdominal cramping.

Rare But Serious: Nausea, rash dizziness & dry mouth.

PREGNANCY & LACTATION

Pregnancy: Safe.

Lactation: Safe.

Parameters To Monitor: Frequency and volume of bowel movements.

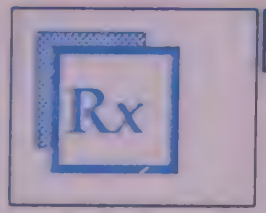
Precautions: Use with caution in ulcerative colitis.

Patient Instructions: May cause drowsiness or dizziness. Caution while performing tasks that require mental alertness.

Pharmacology: A synthetic antidiarrheal, structurally similar to haloperidol that causes a dose related inhibition of colonic motility without significant opiate activity.

Available As: Cap 2 mg, liq 1 mg/5mL.

Mannitol

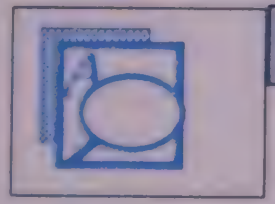


INDICATIONS & DOSE

To prevent acute renal failure:-
Route: IV; *Dose:* 50-100g as 5%- 25% solution in 1 hr as loading dose. Then maintain urine output as 50ml/hr.

Reduction of intracranial & intra-ocular tension:- *Route:* IV; *Dose:* 1.5-2g/kg infusion as 15-25% solution over 30-60 minutes.

Intoxications:- *Route: IV; Dose:* 10g/hr for 6hrs as20%solution. Maintain urine output as 150-500 mL/hr.
Paediatric Use 2g/kg as 5-25% solution as needed

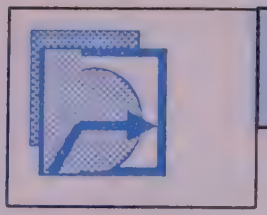


ADVERSE REACTIONS

Common: Fluid & electrolyte imbalances.

Occasional: CCF, pulmonary edema, water intoxication, hypertension, necrosis of skin if solution extravasates.

Rare But Serious: Anaphylaxis.



PREGNANCY & LACTATION

Pregnancy: Avoid.

Lactation: Avoid.

CONTRAINDICATIONS

Established anuria, pulmonary congestion/edema, severe CCF, active intracranial bleeding except during craniotomy.

Warnings: Masking of inadequate hydration, hypovolemia may occur. Never give IM or SC injections.

Precautions: Observe for crystals in solution beforehand.

Parameters To Monitor: Urine output, serum electrolytes.

Pharmacology: Increases serum osmolality (osmotic diuretic), expanding intravascular volume and decreasing intra-ocular and intracranial pressures. Disrupts blood brain barrier, enhancing penetration of drugs to CNS.

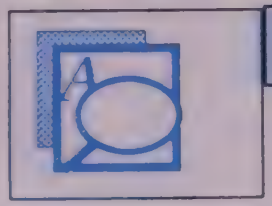
Mebendazole

INDICATIONS & DOSE

Pinworms:- *Route:* PO; *Dose:* 100mg single dose.

Round,whip &hookworms:- *Route:* PO; *Dose:* 100mg, q 12 hrs for 3 days. Repeat treatment after 3 weeks.

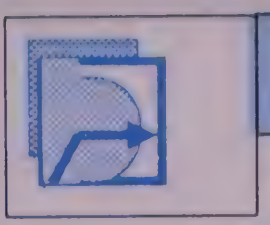
Paediatric Use: Safe in children over 2 yrs. *Dose:* Same as adult dose PO.



ADVERSE REACTIONS

Occasional: Abdominal pain and diarrhea during expulsion of worms.

Rare But Serious: Fever due ıo drug induced tissue necrosis.



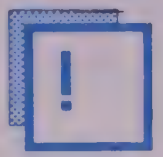
PREGNANCY & LACTATION

Pregnancy: Contraindicated.

Lactation: Safety not established.

CONTRAINDICATIONS

Hypersensitivity.



Parameters To Monitor: In whipworm infection stool for egg count should be taken 3 weeks after treatment to detect persistent infestation.

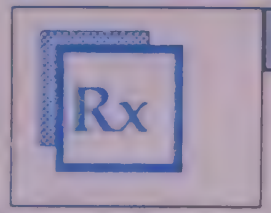
Patient Instructions: Tablet may be chewed, swallowed or mixed with food. Whole family should be treated. Disinfect undergarments, bed linens, towels, nightclothes & toilet facilities daily.

Precautions: In chidren under 2 yrs.

Pharmacology: Inhibits glucose uptake in the parasite with no effect on blood sugar concentration in the host.

Available As Tab: 100mg

Methanamine



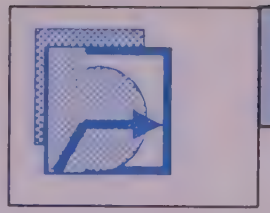
INDICATIONS & DOSE

Prevention of recurrent UTI:- *Route:* PO; *Dose:* 1g, q 6hrs.

Paediatric Use:- 500mg, q 6hrs.

ADVERSE REACTIONS

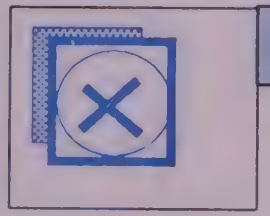
GI distress, urticaria, genaralised edema and hematuria.



PREGNANCY & LACTATION

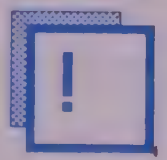
Pregnancy: Safe.

Lactation: Safe.



CONTRAINDICATIONS

Moderate to severe renal insufficiency, hepatic failure



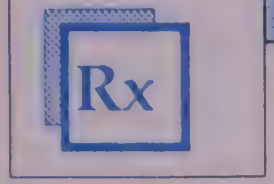
Patient Instructions: Take drug after food. Patients must take at least 4g/day of ascorbic acid to adequately acidify urine.

Precautions: Maintain an acidic urine pH, restrict fluid intake. Use with caution in the elderly & the debilitated.

Pharmacology: Weak urinary antiseptic. The drug is converted to ammonia and formaldehyde in acidic urine. Ineffective in alkaline urine and in the presence of urea splitting organisms (Proteus).

Available As: 0.5 & 1g tablets and granules; 250, 500 mg / 5 mL suspension.

Metoclopromide



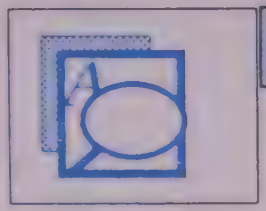
INDICATIONS & DOSE

Gastroesophageal reflux:- *Route:* PO; *Dose:* 10-15mg, q 6h, 30mins before meals.

Diabetic gastroparesis:- *Route:* PO/IM; *Dose:* 10mg, q 6h, 30min before meals.

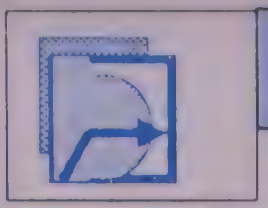
Prevent emesis induced by chemotherapy:- *Route:* IV; *Dose:* 2mg/kg, 30 min before and every 2h, for 2 doses and q 3h for 3 doses. Dilute IV doses in excess of 10 mg to 50 mL and infuse over atleast 15 minutes.
Others:- To facilitate small bowel intubation or to aid in radiologic procedures

Paediatric Use: 0.1-2.5mg/kg IV.



ADVERSE REACTIONS

Drowsiness, restlessness, fatigue, extrapyramidal reactions, endocrine disturbances.



PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation: Use with caution.

CONTRAINDICATIONS

GI hemorrhage, obstruction or perforation, pheochromocytoma, epilepsy, concurrent use of drugs causing extrapyramidal effects.

Parameters To Monitor: Serum creatinine.

Precautions: Use with caution in hypertensives, patients recieving MAO inhibitors, sympathomimetics or heterocyclic antidepressants.

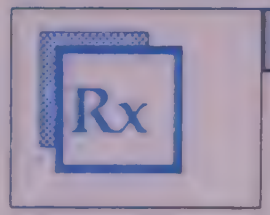
Pharmacology: Sensitises GI receptors to acetylcholine, antagonises the central and peripheral effects of dopamine; exerts a direct effect on smooth muscles.

Patient Instructions: Take before meals & at bedtime. Avoid driving or alcohol intake.

If extrapyramidal symptoms occur administer diphenhydramine 50 mg IM or benztropine 1-2 mg IM.

Available As: 5, 10 mg tablets; 1 mg/mL syrup; 5 mg/mL injection.

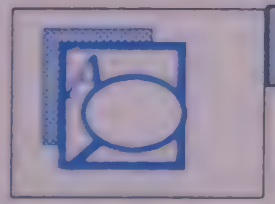
Methanamine



INDICATIONS & DOSE

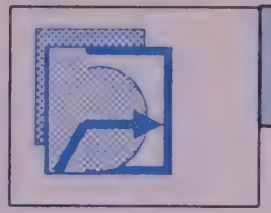
Prevention of recurrent UTI:- *Route:* PO; *Dose:* 1g, q 6hrs.

Paediatric Use:- 500mg, q 6hrs.



ADVERSE REACTIONS

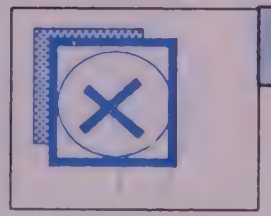
GI distress, urticaria, genaralised edema and hematuria.



PREGNANCY & LACTATION

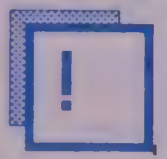
Pregnancy: Safe.

Lactation: Safe.



CONTRAINDICATIONS

Moderate to severe renal insufficiency, hepatic failure



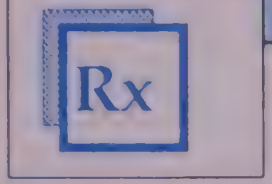
Patient Instructions: Take drug after food. Patients must take at least 4g/day of ascorbic acid to adequately acidify urine.

Precautions: Maintain an acidic urine pH, restrict fluid intake. Use with caution in the elderly & the debilitated.

Pharmacology: Weak urinary antiseptic. The drug is converted to ammonia and formaldehyde in acidic urine. Ineffective in alkaline urine and in the presence of urea splitting organisms (Proteus).

Available As: 0.5 & 1g tablets and granules; 250, 500 mg / 5 mL suspension.

Metoclopromide



INDICATIONS & DOSE

Gastroesophageal reflux:- *Route:* PO; *Dose:* 10-15mg, q 6h, 30mins before meals.

Diabetic gastroparesis:- *Route:* PO/IM; *Dose:* 10mg, q 6h, 30min before meals.

Prevent emesis induced by chemotherapy:- *Route:* IV; *Dose:* 2mg/kg, 30 min before and every 2h, for 2 doses and q 3h for 3 doses. Dilute IV doses in excess of 10 mg to 50 mL and infuse over atleast 15 minutes.
Others:- To facilitate small bowel intubation or to aid in radiologic procedures

Paediatric Use: 0.1-2.5mg/kg IV.

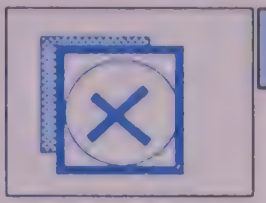
ADVERSE REACTIONS

Drowsiness, restlessness, fatigue, extrapyramidal reactions, endocrine disturbances.

PREGNANCY & LACTATION

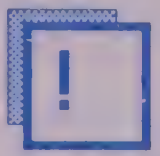
Pregnancy: Use with caution.

Lactation: Use with caution.



CONTRAINDICATIONS

GI hemorrhage, obstruction or perforation, pheochromocytoma, epilepsy, concurrent use of drugs causing extrapyramidal effects.



Parameters To Monitor: Serum creatinine.

Precautions: Use with caution in hypertensives, patients recieving MAO inhibitors, sympathomimetics or heterocyclic antidepressants.

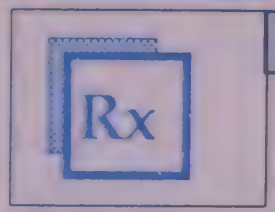
Pharmacology: Sensitises GI receptors to acetylcholine, antagonises the central and peripheral effects of dopamine; exerts a direct effect on smooth muscles.

Patient Instructions: Take before meals & at bedtime. Avoid driving or alcohol intake.

If extrapyramidal symptoms occur administer diphenhydramine 50 mg IM or benztropine 1-2 mg IM.

Available As: 5, 10 mg tablets; 1 mg/mL syrup; 5 mg/mL injection.

Metronidazole



INDICATIONS & DOSE

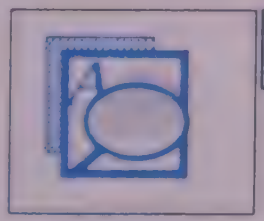
Trichomoniasis *Route* PO *Dose* 2g single dose

Amoebiasis (Intestinal & Extra Intestinal) *Route* PO *Dose* 750 mg q 8hrs,5-10 days

Anaerobic infection:- *Route*: PO/IV; *Dose:* 15mg/kg initially, 7.5mg/kg, q 6hrs to a maximum of 4 g/day. Infuse each IV dose over 1 hour.

Others:- Non specific vaginitis, antibiotic associated colitis, active and chronic Crohn's disease and Crohn's patients with refractory perineal disease.

Paediatric Use: 25-50 mg/kg/day in 3 divided doses to a maximum of 2.4 g/day.

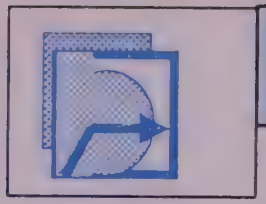


ADVERSE REACTIONS

Common: Metallic taste in mouth & GI complaints. Phlebitis in IV therapy.

Occasional: Dizziness, vertigo, parasthesias, reversible mild neutropenia.

Rare But Serious: Antibiotic associated colitis, reversible peripheral neuropathy on prolonged therapy.



PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation: Use with caution.

CONTRAINDICATIONS

First trimester of pregnancy.

Patient Instructions: Take drug with food. May cause dark coloration of urine and metallic taste in mouth. Has antabuse like reaction.

Precautions: Active CNS disease or neutropenia, patients receiving corticosteroids or patients predisposed to edema.

Parameters To Monitor: WBC count before and after prolonged therapy.

Pharmacology: Bactericidal against nearly all obligate anaerobic bacteria, including Bacteroides fragilis, also against T vaginalis, E histolytica & G lamblia. Inactive against aerobic and microaerophilic bacteria.

Available As : Tab 200, 400mg.

Morphine

INDICATIONS & DOSE

For analgesia:- *Route:* PO; *Dose:* 8-20 mg, q 6h.
Route: IM/SC; *Dose:* 5-15 mg, q 4h.

Route: IV; *Dose :* 4-10 mg over 5 mins; infusion 1-10 mg/hr.

Others:- Myocardial infarction, dyspnoea due to acute pulmonary edema and left ventricular failure, preoperative sedation, allay apprehension, facilitate induction of anesthesia & reduce anesthetic dosage and for postoperative pain.

Paediatric Use: 0.1 -0.2 mg/kg/dose upto 15mg SC/IM; or half the dose IV.

ADVERSE REACTIONS

Common: Respiratory & circulatory depression.

Occasional: Sedation, dizziness, vomiting, sweating, constipation, euphoria, dysphoria, syncope, postural hypotension & allergy like reactions.

Toxicity: Dose related miosis, drowsiness, depressed respiration, bradycardia, hypotension.

PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation: Safe.

Parameters To Monitor: Signs of respiratory or cardiovascular depression.

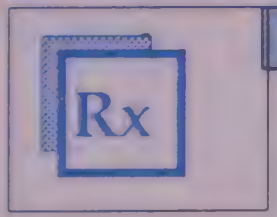
Precautions: Reduce dose when using with other CNS depressants. Use with caution in intracranial tension, COPD, respiratory depression, hypoxia, hypercapnia, compromised circulation, supraventricular tachycardia, prostatic hypertrophy and debilitating illness. Use in acute abdominal pain may mask the diagnosis and clinical course.

Pharmacology: Interacts with stereospecific opiate receptors in the CNS and other tissues; produces analgesia by altering the emotional response to pain. Other sensory modalities are unaffected. Antitussive in lower doses

Note: Bromptom's cocktail used in the therapy of chronic pain is not superior to morphine alone.

Do not administer IV unless a narcotic antagonist and facilities for assisted and controlled respiration are available.

Nalidixic acid

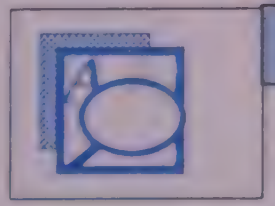


INDICATIONS & DOSE

Urinary tract infections :- *Route:* PO; *Dose:* 1g, q 6 hrs.

Reserved for UTI caused by Enterobactor, Kiebsiella and Proteus strains

Pediatric Use : Not recommended under 3 months of age. Dose: 55mg/kg/day.

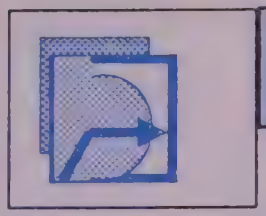


ADVERSE REACTIONS

Common: Drowsiness, headache, vertigo, visual disturbances.

Occasional: GI upset, allergy, photosensitivity.

Rare but serious: Toxic psychosis, pancytopenia, cholestatic jaundice.



PREGNANCY & LACTATION

Pregnancy : Do not use in the first trimester.

Lactation: Avoid.

CONTRAINDICATIONS

Hypersensitivity, h/o convulsive disorders.

Parameters to monitor : Periodic CBC, renal & liver function test.

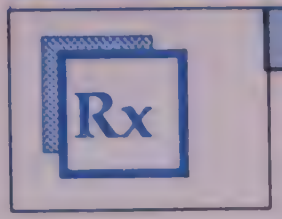
Patient Instructions: Take with food, observe caution while driving

Pharmacology: Bactericidal with predominantly gram -ve spectrum of action.

Available As : Tab 500mg

Laboratory interference : May cause elevations of urine sugar measurements.

Nifedipine



INDICATIONS & DOSE

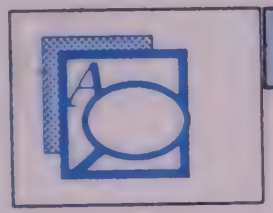
Hypertensive emergencies :- *Route:* SL; *Dose*: 10mg, tid.

Antianginal:- *Route:* PO/SL; *Dose*: 10mg, tid/qid.

Hypertension:- Route: PO; Dose : 10 - 20 mg tid maximum 180 mg/day.

Other Indications: Chronic stable and vasospastic angina; Variant angina refractory to nitrate therapy; unloading agent in CHF.

Pediatric Use: Safety not established.



ADVERSE REACTIONS

Common: Dizziness, headache, edema.

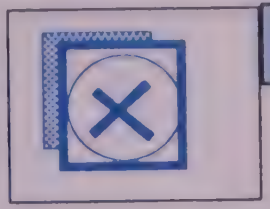
Occasional: Orthostatic hypotension, CHF.

Rare but serious: Hepatitis, hyperglycemia, acute reversible renal failure in patients with chronic renal failure.

PREGNANCY & LACTATION

Pregnancy: Safety not established.

Lactation: Avoid.



CONTRAINDICATIONS

Symtomatic hypotension.

Parameters to monitor : BP & heart rate on initiation. Serial treadmill tests to assess efficacy.

Precautions: Avoid use as single agent in unstable angina; has antiplatelet action; may worsen symptoms in cardiomyopathy.May increase Quinidine levels.

Patient Instructions: Report flushing, edema, chest discomfort.

Pharmacology: Negative inotropic, coronary &peripheral vasodilator.

Available as : cap 10, 20 mg.

Do not use by the sublingual route if there is clinical and ECG evidence of left ventricular hypertrophy.

Pentazocine

INDICATIONS & DOSE

Analgesic:- *Route:* PO; *Dose :* 50-100 mg, q 4hr, maximum 600 mg/d.

Route: IM; Dose: 30-60 mg, q 4hr maximum 360 mg/d.

Route: IV; *Dose:* 30 mg q 4hr, maximum 360 mg/d

Paediatric Use:- Not recommended under 12 years.

ADVERSE REACTIONS

Common: Sedation, sweating, dizziness, euphoria, hallucinations & GI distress.

Occassional: Insomnia, anxiety, constipation, dry mouth, syncope.

Rare but serious: Muscle tremor, toxic epidermal necrolysis, local skin reactions, ulceration and fibrous myopathy at the site of injection.

PREGNANCY & LACTATION

Pregnancy: Avoid during labor.

Lactation: Safety not established.

CONTRAINDICATIONS

Hypersensitivity to pentazocine or naloxone.

Parameters to monitor: Signs of respiratory or cardiovscular depression

Precautions: Increases cardiac workload so should not be used in myocardial infarction. *See morphine*. There are reports of dependence and withdrawal symptoms follwing extended use. Use with caution and in reduced dosage when used concurrently with CNS depressants. Use with caution in head injury, intracranial lesions and prexisting increase in intracranial pressure.

Patient instructions : This drug may cause dizziness. Report mental changes. Avoid alcohol, driving & CNS depressants.

Pharmacology : Narcotic analgesic with weak opioid antagonist activity.

Available As: tab 50mg (with naloxone 0.5 mg) Inj 30mg/mL

Phenobarbital

INDICATIONS & DOSE

Epilepsy:- *Route:* PO; *Dose:* 30mg, q 12hrs initially; increase in 60mg/d increments every 5 days to effective dose (usually 2-3 mg/kg/d).

Sedation & hypnosis:- *Route:* PO; *Dose*: 100 mg, q 12 hrs.

Status epilepticus:- *Route:* IV; *Dose:* 250mg, at 60-100mg/min; Repeat in 30 min. if necessary to a maximum of 20mg/kg.

Other Indications: Preanaesthetic, acute convulsive episodes(eclampsia, meningitis, tetanus and toxic reactions to strychinine).

Pediatric Use: Dose: 3-6 mg/kg/day in two or three divided doses.

ADVERSE REACTIONS

Common: Sedation, tolerance, behavioral disturbances. Toxicity is related to plasma levels (40mcg/mL).

Occassional: Skin rashes, folate deficiency.

Rare but serious: Hepatitis, Steven Johnson syndrome, tissue necrosis & respiratory depression.

PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation: Use with caution.

CONTRAINDICATIONS

H/O porphyria or severe respiratory disease with obstruction.

Parameters to monitor : Periodic plasma levels after 14 -21 days, complete blood count & liver function tests.

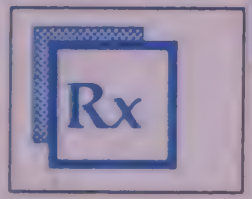
Precautions: Neonatal hemorrhage is known to occur when mothers are on phenobarbital therapy Use with caution in liver and renal disease. Abrupt withdrawal may precipitate status epilepticus.

Patient instructions: Causes drowsiness, so avoid driving. Avoid alcohol. Don't stop therapy suddenly.

Pharmacology : Sedative, hypnotic & anticonvulsant. It increases the threshold of stimulation and suppresses the spread of seizure discharge.

Avaialble As: Tab 8, 16, 32 & 65 mg; Inj 30, 60 mg/mL

Probenecid



INDICATIONS & DOSE

Chronic gout :- *Route*: PO; *Dose:* 250 mg, q 12 hrs for 1 week; then 500 mg q 12 hrs.

To prolong action of penicillin and cephalosporin:- Route: PO; Dose: 500 mg q 6 hrs.

Pediatric Use: Not recommended in children under 2 years. Dose: 25 mg/kg initially; then 40 mg/kg/day in 4 divided doses.

ADVERSE REACTIONS

Occasional: Headache, GI upset & skin rash.

Rare but serious : Exacerbation of gout and uric acid stones. Nephrotic syndrome and hepatic necrosis a part of hypersensitivity. Aplastic anemia and hemolytic anemia due to G6PD deficiency.

PREGNANCY & LACTATION

Pregnancy: Avoid.

Lactation: Avoid.

CONTRAINDICATIONS

Children under 2 years, known blood dyscrasias or uric acid kidney stones, initiation of therapy during an acute gouty attack.

Parameters to monitor : Serum uric acid levels. Pretreatment 24 hour urinary uric acid excretion.

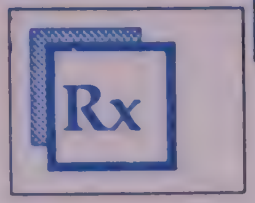
Precautions : In patients with peptic ulcer.

Patient instructions : Take drug with food, milk or antacid. Drink large amount of water. Avoid use of aspirin.

Pharmacology : Inhibits renal tubular reabsorption of urate, also interferes with renal tubular secretion of many drugs.

Available As : Tab 500mg

Procaine penicillin



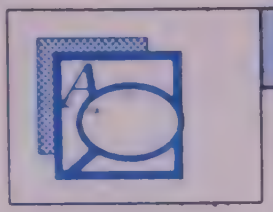
INDICATIONS & DOSE

Pneumococcal pneumonia:- *Route:* IM; *Dose:* 600,000-1.2 million units/day.

Neuro syphilis:- *Route:* IM; *Dose:* 2.4 million units/day plus probenecid 500 mg qd for 10 days followed by benzathine penicillin 2.4 million units IM every week for three doses

Gonorrhea:- *Route:* IM; *Dose*: 4.8 million units/day in two divided doses together with one gram of probenecid orally, given at two different sites.

Pediatric use: *Dose:* 25000--50000 U/kg/day.



ADVERSE REACTIONS

Common: Hypersensitivity.

Occasionally: Bone marrow depression, interstitial nephritis, neurotoxicity.

Rare but serious: Jarish-Herxheimer's reaction, acute psychotic reactions.

PREGNANCY & LACTATION

Pregnancy : Safety not established.

Lactation : Avoid.

CONTRAINDICATIONS

Hypersensitivity.

Precautions : Use with caution in cases of allergy, renal, cardiac & seizure disorders.

Patient instructions : Notify physician if skin rashes occur.

Pharmacolgy: Bactericidal; spectrum includes gram +ve & gram -ve cocci, some gram +ve bacilli.

Avaialble As: Inj 300,000, 500,000 units/mL.

Promethazine

INDICATIONS & DOSE

Allergy:- *Route:* PO; *Dose*: 25-50 mg.

Eclampsia:- *Route:* IM; *Dose:* 25 mg, q 8 hrs.

Emesis:- *Route:* PO; *Dose:* 25 mg.

Other indications: sedation, pre & post operative sedation.Motion sickness, nausea & vomiting, adjunct to anaesthesia (lytic cocktail).

Pediatric Use:- *Dose*12.5-25 mg (1 mg/kg).

ADVERSE REACTIONS

Common: Hypotension, CNS depression, GI distress, agranulocytosis.

Occasional: Thickening of bronchial secretion, palpitations.

Rare but serious: Urinary frequency, retention, early menses, impotence.

PREGNANCY & LACTATION

Pregnancy : Safe.

Lactation : Contraindicated.

CONTRAINDICATIONS

New born & premature infants, hypersensitivity, MAO inhibitor therapy, nursing mothers, narrow angle glaucoma, coma, prostatic hypertrophy.

Precautions: Use with caution in patients with cardiovascular disease, impaired hepatic function & ulcer disease.

Patient instructions : may cause drowsiness, observe caution while driving. Avoid alcohol & other CNS depressants. Take with food. May cause dry mouth.

Pharmacology : Sedative, antihistaminic, anticholinergic & antiemetic.

Available As : Tab 25 mg

Propranolol

INDICATIONS & DOSE

Antihypertensive:- *Route:* PO; *Dose:* 10-20 mg, q6hr initally increased gradually; consider adding another agent if 480 mg/d is ineffective

Antiarrhythmic:- *Route :* PO; *Dose:* 10-30mg 6-8hrs

Antianginal:- *Route:* PO *Dose:* 20-30mg, q 12h.

Other indications : Hypertrophic subaortic stenosis, stable MI, mitral valve prolapse syndrome, phaeochromocytoma, cirrhosis, schizoprenia, tremors, stage fright & tardive dyskinesia.

Pediatric use : Dose: .5-1mg/kg/day PO (maximum of 60mg/d)

ADVERSE REACTIONS

Common: Exacerbates previous asthma, renal dysfunction, Raynaud's disease.

Occassional: Acute heart failure, hypotension,heart block, bradycardia.

Rare but serious: Precipitates hypoglycemia,depression.

PREGNANCY & LACTATION

Pregnancy : Safety in pregnancy not established.

Lactation : Safe.

CONTRAINDICATIONS

COPD, CHF, heart block, sinus bradycardia, asthma.

Parameters to monitor : BP & pulse during IV use q 5mts with constant EKG monitoring

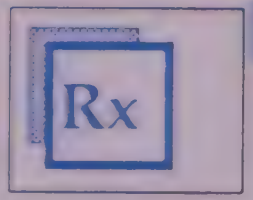
Precautions: Abrupt drug cessation in coronary disease may precipitate MI or unstable angina. May worsen atrial fibrillation.In phaeochromocytoma, start after alpha - blocker.

Patient instructions: Report any signs of respiratory discomfort. Do not stop drug abruptly.

Pharmacology: non selective beta blocker with membrane stabilising activity.

Available As : tab 10, 20, 40, 60 & 80mg SR cap 60, 80, 120 mg; Inj 1mg/mL

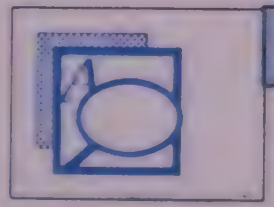
Pyrazinamide



INDICATIONS & DOSE

Tuberculosis:- *Route :* PO *Dose:* 20-35mg/kg/day

Pediatric Use :- Avoid.

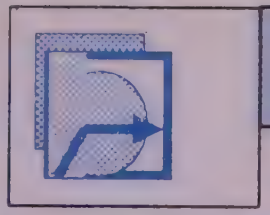


ADVERSE REACTIONS

Common: Hepatic cell dysfunction, GI distress.

Occasional: Hyperuricemia, urticaria.

Rare but serious: Fulminant hepatic failure.



PREGNANCY & LACTATION

Pregnancy : Avoid.

Lactation: Avoid

CONTRAINDICATIONS

Severe hepatic damage.

Parameters to monitor : LFT, blood uric acid

Precautions: Use with caution in gout, diabetes mellitus & porphyria.

Patient instructions : Notify physician if malaise, dark urine, yellow discoloration of skin and eyes or symptoms of gouty arthritis occur.

Interference with Laboratory tests: may cause elevation of uric acid levels.

Pharmacology : Bacteriostatic

Available As : Tab 500mg.

Quinidine

INDICATIONS & DOSE

Atrial fibrillation & flutter; paroxysmal atrial, nodal & ventricular tachycardia; premature beats; ventricular fibrillation & flutter during surgery

Route: PO; *Dose:* Loading dose - 200mg, q2h, for 5-6 doses; Maintenance Dose - 200-600mg, q 6-8hrs.

IV (as gluconate) ; *Dose:* 5-8 mg/kg at a rate of 0.3 mg/kg/min.

IM not recommended.

Paediatric Use: *Route*: PO; *Dose:*15-60mg/kg/day. IM and IV - not recommended

ADVERSE REACTIONS

Common: Ventricular arrhythmias, torsa des pointes, hypotension, syncope, diarrhea; may aggravate underlying arrythmias or heart failure.
Occasional: Cinchonism - tinnitus, blurred vision, vertigo, tremors.
Rare but serious: Embolic phenomena, idiosyncratic reactions (hepatitis, anaphylactoid reactions, SLE, hemolytic anemias).

PREGNANCY & LACTATION

Pregnancy: Use with caution.

Lactation: Avoid.

CONTRAINDICATIONS

Idiosyncracy, syncope, 2 or 3 degree heart block, severe sinus node dysfunction, long QT syndromes.

Parameters to monitor: ECG for QT, QRS or PR prolongation & BP. Platelet count, liver enzymes & hematocrit if idiosyncracy is suspected.

Precautions: Exacerbates myasthenia gravis.Therapy should be initiated only after hospitalisation. In atrial flutter or fibrilation, start digoxin, propranolol or verapamil before initiating quinidine. May increase digoxin levels.

Patient Instructions: Report blurred vision, tinnitus, diarrhea, abnormal bleeding, dizziness, rash or fainting episodes.

Pharmacology: Class I antiarrhythmic agent which slows conduction velocity, prolongs effective refractory period, decreases automaticity of normal & diseased fibres.

Available As: Tab 100, 200 mg;
Inj 80 mg/mL (gluconate)

Rifampicin

INDICATIONS & DOSE

Tuberculosis:- *Route:* PO;
Dose: 600mg, q 24hrs in combination with at least one other antimycobacteril agent.

Meningococcal meningitis:- *Route:* PO;
Dose: 600mg, q 12hrs.

Other Indications:- Leprosy.

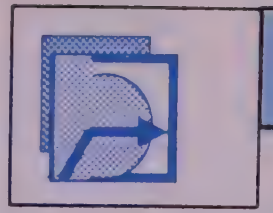
Pediatric Use: 10-20mg/kg/day.

ADVERSE REACTIONS

Common: GI distress, subclinical hepatitis.

Occasional: Urticaria, ataxia.

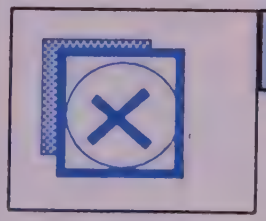
Rare but Serious: Renal & hepatic failure.



PREGNANCY & LACTATION

Pregnancy : Avoid.

Lactation: Avoid.



CONTRAINDICATIONS

Previous rifampicin associated hepatitis.

Parameters to monitor: Signs of hepatitis, SGOT, SGPT (monthly in alcoholics and with prexisting hepatitis - not predictive in the absence of symptoms).

Precautions: Use with caution in alcoholics & in preexisting liver disease.

Patient Instructions: Take on empty stomach. This drug may colour urine, sweat & faeces red.

Pharmacology: Bactericidal, acts on persisters. Spectrum includes some gram positive and gram negative bacteria especially N meningiditis.

Available As : Cap 150 & 300 mg.

Salbutamol

INDICATIONS & DOSE

Bronchial asthma:- *Route*: PO; *Dose*: 2-4mg, q 6-8 hrs.

Route: Inhl; *Dose::* inhalations, q 4-6 hrs.

Paediatric use: Avoid.

ADVERSE REACTIONS

Restlessness, anxiety,palpitations, GI distress

PREGNANCY & LACTATION

Pregnancy : Avoid.

Lactation: Safety not established

CONTRAINDICATIONS

Hypersensitivity.

Precautions : May aggravate preexisting diabetes mellitus or ketoacidosis.Avoid concomitant use with other sympathomimetics; do not use on a routine basis.

Pharmacology : Produce bronchodilation by relaxing the smooth muscles of bronchioles by stimulation of B2 receptor

Available As: Tab 2, 4 mg; Inh 100mcg/dose.

Spironolactone

INDICATIONS & DOSE

Edema:- *Route:* PO; *Dose* : 25-200mg/day.

Hypertension:- *Route:* PO; *Dose:* 50-100mg/day.(up to 400mg/day in primary aldosteronism).

Ascites:- *Route :* PO; *Dose :* 100mg/day initially ;200-400mg/day.

Pediatric use : 3.3-10mg/kg/day. Restrict duration of therapy to one month.

ADVERSE REACTIONS

Common : Hyperkalemia, dehydration, hyponatremia, hyperchloremic acidosis.
Occasional: Gynecomastia, hirsutism, menstrual irregularities.

PREGNANCY & LACTATION

Pregnancy : Avoid

Lactation : Avoid

CONTRAINDICATIONS

Anuria, acute renal failure, potassium > 5.5mEQ/L, serum creatinine > 2.5 mg/dl

Parameters to monitor : Serum electrolytes, BUN, serum creatinine daily weight (in ascites ; loss should not be greater than 0.5 - 1.0 kg/d)

Precautions : Tumorogenic in animals. Use only if necessary. Use with caution in renal & hepatic dysfunction. Do not give with triamterene or amiloride.

Patient instructions : Avoid high potassium foods or salt substitutes.

Pharmacolgy : Aldosterone antagonist, positive inotropic action, potassium sparing diuretic.

Available As: Tab 25, 50, 100 mg.

Streptomycin

INDICATIONS & DOSE

Enterococcal endocarditis, tuberculosis, brucellosis, plague & tularemia.

Route: IM; *Dose :* 15-25mg/kg/day.

Pediatric use: Dose : 20-30 mg/kg/day.

ADVERSE REACTIONS

Common: Nephrotoxicity.

Occasional: Vestibular and cochlear damage.

Rare but serious: Neuromuscular blockade with respiratory failure.

PREGNANCY & LACTATION

Pregnancy : Use with caution.

Lactation : Avoid.

CONTRAINDICATIONS

End stage renal disease.

Parameters to monitor : Renal function tests, auditory and vestibular impairment.

Precautions : Use with caution in pre-existing renal, vestibular or cochlear impairment, myasthenia gravis, hypocalcemia, & postoperative states.

Patient instructions : Report any dizziness or sensations of ringing or fullness in the ears.

Pharmacology : Spectrum includes gram -ve aerobic infections. Poor activity against P aeruginosa.

Available As: Inj 400, 500 and 1000 mg.

Cotrimoxazole

INDICATIONS & DOSE

Urinary tract infections (UTI):- *Route :* PO; *Dose:* 800 mg of SMZ, 160 mg TMP.

Severe gram -ve infections:- *Route* : IV; *Dose* : 40-50mg/kg/day of SMZ, 8-10mg/kg/day of TMP.

Pneumocystis carinii pneumonia:- *Route :* PO/IV; *Dose:* 100/75 mg/kg/day of SMZ, 20/15 mg/kg/day of TMP.

Other indications : Chronic bronchitis, sepsis, enteric fever, prostatitis,endocarditis.

Pediatric use : *Dose*: 40mg/kg/day of SMZ, 8mg/kg/day. of TMP.

ADVERSE REACTIONS

Common: Blood dyscrasias (megaloblastic, hemolytic anemia, leukopenia, thrombocytopenia

Occasional: Hypersensitivity, rashes, jaundice and kernicterus in neonates.

PREGNANCY & LACTATION

Pregnancy : Contraindicated.

Lactation : Use with caution.

CONTRAINDICATIONS

Pregnancy, infants under 2 months, megaloblastic anemia due to folate deficiency

Parameters to monitor : Baseline and periodic CBC for patients on long term or high-dose treatment.

Precautions : Lactation, H/O hypersessitivity, G6PD deficiency & impaired renal or hepatic function.

Patient instructions : Drug to be taken on empty stomach with a lot of water.

Interference with laboratory tests : false positive urinary glucose test when tested by Benedicts test.

Pharmacology : All gram positive bacteria except anaerobes, Ps aeruginosa & S faecalis. Also effective against protozoa, pneumocystis carinii.

Avaialble As: Tab 400/80 mg; 800/160mg Inj 80/16 mg/mL; Susp 40/8 mL.

Sulfonylureas

INDICATIONS & DOSE

Diabetes mellitus: PO *Dose:* variable depending on length of action. See spread sheet of drug before use. Titrate dose to glucose response.

Pediatric use : Safety not established.

ADVERSE REACTIONS

Common: GI distress, allergy.

Occasional: Hypoglycemia.
Rare but serious: Hematologic disorders, hepatic damage, bone marrow supression, disulfiram like reaction, cholestatic jaundice, SIADH (chlorpropamide).

PREGNANCY & LACTATION

Pregnancy : Avoid.

Lactation : Avoid.

CONTRAINDICATIONS

Pregnancy, insulin dependent diabetes, diabetes complicated by acidosis, ketosis, diabetic coma, surgery, infection, trauma, juvenile, unstable or brittle diabetes.

Parameters to monitor : Clinical symptoms of hyper and/or hypoglycemia. Fasting & postprandial plasma glucose levels, liver functions frequently.

Precautions : Obese patients, not insulin dependent, may develop CVS complications. Some of these products contain tartrazine, therefore, avoid in susceptible patients

Patient instructions : Report side effects. Take dose at same time each day. Do not discontinue medication except on advice of physician. Avoid alcohol & salicylates. Approved diet should be consistent.

Pharmacology : Acutely enhance insulin secretion & potientiate insulin action on several extrahepatic tissues. Chronically increase peripheral utilization of glucose, increase sensitivity and/or the number of insulin receptors.

Tetracyclines

INDICATIONS & DOSE

Indications :- Trachoma, cholera, gonorrhea, syphilis,traveller's diarrhoea.

Route : PO; *Dose* : 250-500 mg, q 6-12 hrs.

Syphillis:- *Route* : IV; *Dose* : 200 mg 1-2 divided doses.

Pediatric use : 25 - 50 mg/kg/d, q 6 -12h (not recommended under 8 years).

ADVERSE REACTIONS

Common : GI distress, discoloration of teeth in children.

Occasional : Phototoxic skin reaction.

Rare but serious : Fanconi like syndrome on administration of outdated drug.

PREGNANCY & LACTATION

Pregnancy : Avoid.

Lactation : Avoid.

CONTRAINDICATIONS

Renal impairment, hepatic dysfunction.

Parameters to monitor : Renal & liver function test.

Precautions : Do not repeat courses in children under 8 yrs. Use with caution in liver impairment.

Patient instructions : Take on empty stomach. Do not take with antacids, dairy & iron products.

Pharmacolgy : Broad spectrum bacteriostatic.

Available As: Cap 100, 250, 500 mg; Tab 250, 500 mg; Susp 125 mg/5mL ; Inj 100, 250, 500 mL; Ophtalmic ointment 1%.

Theophylline

INDICATIONS & DOSE

Acute asthma:- *Route:* IV;
Dose : 5mg/kg at 25mg/min.

Chronic asthma:- *Route :* PO;
Dose: 400mg/day.

Pediatric use : *Dose :* 8mg/kg/day.

ADVERSE REACTIONS

Common : GI upset, restlessness, irritability, insomnia & headache.

Occasional : Serious arrhythmias and convulsions (> 35mcg/ml).

Rare but serious: Rapid IV administration may cause hypotension, syncope, cardiac arrest and death.

PREGNANCY & LACTATION

Pregnancy : Safe.

Lactation : Monitor.

CONTRAINDICATIONS

Hyersensitivity, active peptic ulcer disease.

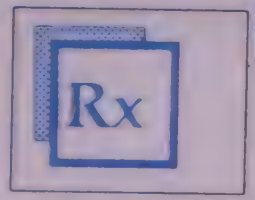
Parameters to monitor : Plasma theophylline concentrations.

Precautions: IM, PR suppositories are not recommended. Do not give with other xanthine preparations. Use with caution in cardiac disease, seizure disorder,CHF, migraine & neonates.

Patient instructions : Do not crush or chew SR tablets. Take at equally spaced intervals.

Pharmacology: Bronchodilator & pulmonary vasodilator. Also a diuretic, coronary vasodilator, cardiac stimulant, cerebral stimulant & it improves diaphragmatic contractility & lessens its fatigue..

Verapamil



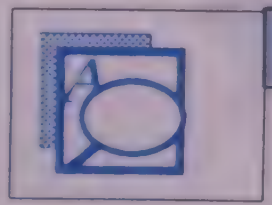
INDICATIONS & DOSE

Antihypertensive:- *Route:* PO; *Dose:* 80mg q 8h SR tabs.

Antiarrhythmic:- *Route:*:IV; *Dose:* 5--10mg over 2-3 mins; followed by 10mg in 30mins if not terminated. (constant infusion 5-10 mg/h)

Antianginal:- *Route :* PO; *Dose :* 80mg q 6-8h increased weekly to a maximum of 320 - 480 mg/d

Pediatric use: *Dose:* 0 .1-.3mg/kg over 2mins (max 5mg).

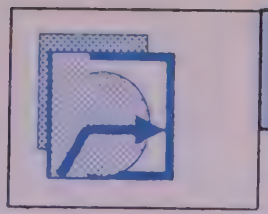


ADVERSE REACTIONS

Common: Constipation, hypotension , bradycardia/asystole.

Occasional: CHF if LV dysfunction is present.

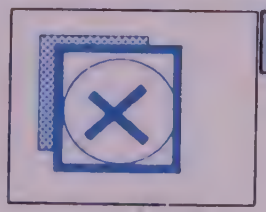
Rare but serious: Vertigo.



PREGNANCY & LACTATION

Pregnancy : Safety not established

Lactations : Safety not established.



CONTRAINDICATIONS

Severe CHF unless due to SVT , cardiogenic shock, AV nodal block, sick sinus syndrome unless pacemaker is in place, concomitant IV B-blocker administration.

Parameters to monitor : BP & ECG during IV therapy.Signs &symptoms of heart failure & hypotension.

Precautions: May increase serum digoxin levels. Use with caution with oral B-blockers and poor left ventricular function.

Patient instructions : Take SR tablets with food.

Pharmacology : Calcium antagonist that prolongs AV nodal conduction, decreases contractility & arteriolar resistance.

Available As: Tab 40, 80, 120 mg; SR Tab 240 mg; Inj 2.5 mg/mL

2

DRUGS IN PREGNANCY

Group	Safe	Use With Caution	Avoid
1. Analgesics & Antipyretics	Paracetamol	Indomethacin[#] Narcotic analgesics[$] Pentazocine	Aspirin*

** Increased perinatal mortality, neonatal bleeding diathesis & prolonged gestation. Low dose aspirin (75 -80 mg) is now recommended for prevention of pregnancy induced hypertension in high risk groups.*

 # Persistent fetal circulation.

$ Neonatal respiratory depression when given during labour.

2. Anticoagulants	Heparin*		Coumarin anticoagualnts[$]

** Maternal bleeding should be watched for. $ Warfarin embryopathy.*

3. Anticonvulsants		Carbamazepine Phenobarbital* Phenytoin* Primidone*	Valproic acid

** Do not withdraw anticonvulsants in pregnancy; use minimum dose required to prevent seizures. There is a 2-3 times increased risk of congential malformations and mental retardation.*

Group	Safe	Use With Caution	Avoid
4. Antidiabetics	Insulin		Sulfonylureas* Biguanides

** May cause prolonged hypoglycemia/hyperinsulinism in the new born.*

5. Antihistamines	Pheniramine Chlorpheniramine Diphenhydramine Meclizine		Brompheniramine
6. Antimicrobials	Amoxicillin Ampicillin Erythromycin Ethambutol Metronidazole Cefazoline Isoniazid Penicillins+ Dapsone	Cotrimoxazole Aminoglycosides@ Chloroquine Pyrimethamine Rifamicin$ Nitrofurantoin Trimethoprim	Tetracylines^ Primaquin Quinine# Carbenicillin+ Norfloxacin+ Chloramphenicol*

** Gray baby syndrome*

 # Maternal deaths, fetal optic & hearing disturbances

$ Give Vit K to mother & neonate to prevent neonatal hypoprothrombinemia

^ Permanant staining of deciduous teeth

Group	Safe	Use With Caution	Avoid
Antimicrobials..			

@ Avoid during first trimesterr

+ No data available

7. Cardiovascular & Anti hypertensive agents	Digoxin Methyl dopa Labetolol Quinidine Hydralazine	Diazoxide Propranolol* Atenolol	Disopyramide Diuretics

** IUGR, neonatal respiratory depresion*

8. CNS agents	Meperidine	Phenothiazines# Diazepam* Anesthetics*	Antidepressants Sympathomimetics

 # Increased risk of malformation reported when used between the 6th and 10th week of gestation. Extrapyramidal effects in the neonate when used near term (data inconclusive)

** Respiratory depression in the newborn*

Group	Safe	Use With Caution	Avoid
9. Diuretics		Furosemide[#]	Thiazides*

 # Only in CHF. Not indicated in hypertension or edema in pregnancy

** Neonatal electrolyte disturbances, hypoglycemia & thrombocytopenia*

10. GI drugs	Antacids Bisacodyl Phenophthalein Metoclopramide Meclizine Doxylamine		H2-antagonists
11. Endocrine agents	Thyroxine Insulins	Propylthiouracil Steroids	Carbimazole[#] Diethylstilbestrol[*] Progesterone[@]

 # Increased incidence of midline scalp defects

** Increased frequency of adenosis, genital cancers, structural defects & infertility in female offspring; increased risk of infertility, urogenital abnormalities and testicular cancer in male offspring*

@ Malformed genitalia; suggested increase in VACTERL cluster of anomalies is a myth

Group	Safe	Use With Caution	Avoid
Miscellaneous	Theophylline		Alcohol Isotretinoin* Narcotics Tobacco

** Vitamin A is terotogenic in animals, producing defects in all body systems. Human reports are anecdotal; vitamin A analogues are teratogenic in humans. As with other drugs, do not use any vitamin unless a defeciency is documented.*

3

DRUGS AND BREAST FEEDING.

Small molecules of ionized/ water soluble drugs diffuse through the lipoid milk - plasma barrier. Unionized/ lipid soluble drugs pass freely through the membrane. Milk, having a lower pH than plasma acts as an ion trap for basic compounds. Acidic drugs are generally inhibited from entering milk. Highly protein bound drugs do not attain concentrations in milk. The milk/plasma (m/p) ratio of a drug is not a reliable indicator of the potential ill effects of drugs excreted in the milk. If it is essential to use drugs listed under *avoid*, discontinue breast feeding during the period of use of the drug.

Drug category	Safe	Use with caution	Avoid
Analgesics & anti pyretics	Acetaminophen Ibuprofen # Mefanamic acid Salicylates & Paracetomol $	Narcotics	Indomethacin Piroxicam Diflusinal Phenylbutazone

 # Ibuprofen is the safest to use during lactation

$ Avoid breast feeding for1 hour after consuming aspirin.

Anticholinergics - *Use with caution.*

Drug category	Safe	Use with caution	Avoid
Anticoagulants	Heparin Warfarin.		Indandiones
Anticonvulsants	Carbamazepine	Phenytoin Phenobarbitone.	Valproic acid

Most anticonvulsants cause drowsiness and hyperexcitability in the infant. Monitoring of plasma levels in the infant recommended

Antihistamines.	Antihistaminics other than those listed under avoid.		High dosed sustained release products and combinations with anticholine rgics and sympathomimetic agents.

Single bedtime doses after the last feed of the infant is ideal and reduces the dose recieved by the infant.

Anti-infective agents	Aminoglycosides # Penicillins Methanamine Trimethoprim Chloroquine	Sulphonamides* 3rd generation cephalosporins Norfloxacin Nitrofurantoin Erythromycin #	Ampicillin Tetracyclines Nalidixic acid + Chloramphenicol Acyclovir

Drug category	Safe	Use with caution	Avoid
Antiinfective agents	Carbenicillin Erythromycin Cephalexin	Isoniazid	Amantidine Metronidazole @ Clindamycin

* *avoid during first two months.*

+ Do not use if infant is less than one month.

@ Give as single 2 gm dosage.-

Antineoplatic agents. *Breast feeding is contraindicated when a person is on an antineoplastic agent..*

Cardiovascular drugs.

1. **B-blockers**	Propranolol Labetolol Metoprolol		Acebutolol Timolol * Nadolol

* *Do not use even by topical route*

2. **Calcium channel blockers**		Verapamil	Diltiazem
3. **Cardiac drugs**	Digoxine Lidocaine	Mexiletine Hydralazine Procainamide Quinidine #	Amiodarone Disopyramide

Drug category	Safe	Use with caution	Avoid
Cardiac drugs....			
# May cause thrombocytopenia; data inconclusive.			
4. Hypotensive agents	Captoril MethylDopa	Clonidine Minoxidil	Reserpine
5. **Diuretics**	Spironolactone	Acetozolamide	Thiazides*
** in large doses ; small doses appear to be safe. Long acting preparations accumalate in infant's plasma.*			
Gastrointestinal drugs		Cimetidine Metoclopramide* Ranitidine	
** Avoid breast feeding 3-4 hours after use.*			
Endocrine drugs.	Desmopressin	Prednisone $^{\$}$ Propylthiouracil T4 & T3 $^{\$}$	Oestrogens* I^{131}

$ Avoid breast feeding 4 hours after use.. Low dose contraceptives are safe

** Supress lactation with bromocriptine.*

Drug category	Safe	Use with caution	Avoid
Psychotherapeutics	Phenothiazines Chlorpromazine	Imipramine Amitryptiline Trazodone Haloperidol Butryophenones	Doxepin Lithium Bromides Diazepam
Miscellaneous	Methyl ergonovine Magnesium Aminophylline Terbutaline Morphine Pethidine Tolbutamide	Baclofen Pyridostigmine # Pentoxyphylline	Dihydroatachysterol Bromocriptine* Ergotamine Iodines

 # Especially in renal failure

** Suppresses lactation*

Use alcohol, caffeine and tobacco in moderation. Withold breast feeding 2-6 hours before and after polio vaccine (no influence if infant is older than 6 weeks).

4 DRUG INTERACTIONS

Drug A	Drug B	Effect	Comment
Acetaminophen	Alcohol	Hepatotoxicity	Reduce use in alcoholics
	Anticholinergics	Decreases the rate of absoprtion of acetaminophen	
	Contraceptives	Hepatic metabolism of acetamino-phen is increased	
Aminoglycosides	Amphotericin B	Nephrotoxicity	Avoid prolonged therapy Repeat renal function tests regularly
	Cephalosporins	Additive nephrotoxicity	Monitor renal function
	Cisplatin	Additive nephrotoxicity	Monitor renal function
	Digitalis glycosides	Oral neomycin impairs absorption	Monitor digoxin levels
	Ethacrynic Acid	Additive ototoxicity	Impaired renal function predisposes to ototoxicity.
	Methoxyflurane	Additive nephrotoxicity	Monitor renal function

Drug A	Drug B	Effect	Comment
Aminoglycosides	Penicillins	Absorption of oral penicillins is reduced by oral neomycin	
		Parenteral penicillins inactivate aminoglycosides totally in vitro	Avoid combination in vitro
	Skeletal muscle relaxants	Prolongs neuromuscular blockade; may cause respiratory paralysis	Avoid when ventilatory equipment is not avaialble
Aminophylline	*See theophylline*		
Antacids	Digitalis	Reduce absorption of digitalis	Give digoxin two hours before antacid
	Iron preparations	Reduce absorption of iron	Separate doses by 2 hours
	Isoniazid	Interferes with absorption	Separate doses by 2 hours
	Quinidine	Reduce quinidine excretion by kidney	Monitor for increased quinidine effect
	Salicylates	Reduce salicylates levels due to enhanced renal metabolism	Monitor plasma salicylate levels
	Tetracyclines	Interferes with absorption of oral tetracyclines	Space doses by two hours

Drug A	Drug B	Effect	Comment
Antacids	Thiazide diuretics	Calcium antacids produce hypercalcemia	
Barbiturates	B blockers	Increases metabolism of B blockers	Adjust dose of B blockers
	Corticosteroids	Increases metabolism of steroids	Regulate dose of steroids
	Griseofulvin	Impaired absorption of B blockers	Administer in numerous small doses
	Oral anticoagulants	Decreased anticoagulant effect	Monitor prothrombin time
	Contraceptives	Stimulates metabolism	Menstrual irregularities Unplanned pregnancies
	Phenothiazines	Increases metabolism of phenothiazines	Regulate dose of phenothiazines
	Quinidine	Enhanced metabolism of quinidine	Monitor for reduced quinidine effect
	Tetracyclines	Increases metabolism of tetracyclines	Regulate dose of tetracyclines
	Tricyclic anti - depressants	Stimulate metabolism of tricyclic antidepressants	Watch for reduced effect of tricyclic antidepressants
	Valproic Acid	Inhibits metabolism of phenobarbital	Reduce dose of phenobarbital

Drug A	Drug B	Effect	Comment
BBlockers	Antidiabetics	*Refer antidiabetics*	
	Barbiturates	*Refer barbiturates*	
	Cimetidine	Enhances effect of B Blockers	Reduce dose of B blockers
	Clonidine	Causes hypertensive reactions	Monitor for hypertensive response
	Rifampin	Enhances metabolism	Adjust dose of B blockers
	Theophylline	selective mutual inhibition	May worsen asthma
Benzodiazepines	Cimetidine	Inhibits elimination of diazepam	Reduce dose of diazepam
	Disulfiram	Inhibits elimination of diazepam	Reduce dose of diazepam
Bicarbonates	Methenamines	Inhibits conversion of methanamine to active form	Select an alternative to either
	Quinidine	*Refer Quinidine*	
	Sympathomimetics	Decrease elimination of catechol-amines	Reduce dose of sympathomimetics

Drug A	Drug B	Effect	Comment
Captopril	Diuretics	Additive hyperkalemia	Monitor potassium levels
	Indomethacin	Reduces hypotensive effect of captopril	Monitor blood pressure
Carbamazepine	Erythromycin	Inhibits metabolism of carbamazepine	Reduce dose ofcarbamazepine
	Isoniazid	Inhibits metabolism of carbamazepine	Reduce dose of carbamazepine
	Theophylline	Enhances metabolism of theophylline	
	Tetracyclines	*Refer tetracyclines*	
Cephalosporins	Aminoglycosides	*Refer aminoglycosides*	
	Frusemide	Nephrotoxicity	Monitor renal function
Chloramphenicol	Barbiturates	Increased effect of barbiturates	Decrease dose of barbiturates
	Phenytoin	Enhances effect of phenytoin; causes nystagmus and ataxia	Use other antibiotic if possible
	Sulfonylureas	Increases half life of sulfonylureas	Reduce dose of sulfonylureas
Cimetidine	Benzodiazepenes	*Refer benzodiazepines*	
	Lignocaine	*Refer lignocaine*	
	Phenytoin	Inhibits metabolism of phenytoin	Reduce dose of phenytoin
	Quinidine	Reduces metabolism of quinidine	Reduce dose of quinidine

Drug A	Drug B	Effect	Comment
Cimetidine	Theophylline	Reduces elimination of theophylline	Reduce dose of theophylline
	Sulfonylureas	*Refer sulfonyl ureas*	
Digitalis	Aminoglycosides	*Refer aminoglycosides*	
	Calcium antagonists	*Refer Verapamil*	
	Diuretics	Increased potassium loss may contribute to digitalis intoxication	Monitor potassium levels
	Penicillamine	Reduces plasma digoxin levels	Adjust dose of digoxin
	Quinidine	Increases digoxin levels	Monitor digoxin levels
	Rifampin	Reduces plasma digoxin levels	Adjust dose of digoxin
	Spironolactone	Reduces elimination of digoxin	Monitor digoxin levels
Dopamine	Phenytoin (IV)	Produces hypotension with IV dopamine	Monitor blood pressure
Erythromycin	Carbamazepine	*Refer carbamzepine*	
	Theophylline	Reduces elimination of theophylline	Reduce dose of theophylline
Frusemide	Cephalosporins	Additive nephrotoxicity	Monitor renal function
	Corticosteroids	Enhancement of potassium depletion	Supplement with potassium
	Digitalis	*Refer digitalis*	

Drug A	Drug B	Effect	Comment
Frusemide	NSAIDS	Hypotensive & natriuretic effect is inhibited	Increase dose of frusemide monitor renal function
Heparin	Salicylates	More prone to hemorrhage	Monitor dose of heparin
Isoniazid	Carbamazepine	*Refer carbamazepine*	
	Phenytoin	Increases hepatotoxicity	Reduce dose of INH
	Rifampicin	Increases hepatotoxicity	Reduce dose of INH
Lignocaine	Cimetidine	Inhibits elimination of lignocaine	Reduce dose of lignocaine
Methyldopa	Antidiabetics	Enhances hypoglycemia	Regulate dose of antidiabetics
Metronidazole	Alcohol	Antabuse like reaction	Warn patient
	Oral anticoagulants	Enhanced hypoprothrombinemic response	Monitor prothrombin time
Nitrates	Alcohol	Severe hypotension may be precipitated	Warn patient
Norepinephrine	Methyldopa	Possible increase in pressor response	
NSAIDS	B Blockers	Inhibition of antihypertensive effect	Regulate dose
	Captopril	*Refer captopril*	

Drug A	Drug B	Effect	Comment
NSAIDS	Furosemide	*Refer furosemide*	
	Potassium sparing diuretics	Reduce renal function	Monitor renal function
	Thiazides	*Refer thiazides*	
Penicillins	Aminoglycoside	*Refer aminoglycosides*	
	Oral Contraceptives	*Refer contraceptives*	
	Probenecid	Reduced renal elimination of penicillins	Reduce dosage of penicillins
	Tetracyclines	Nullifies action of penicillins by bacterial inhibition	Avoid co-administration
Phenytoin	Chloramphenicol	*Refer chloramphenicol*	
	Cimetidine	Inhibits phenytoin metabolism	Decrease dose of phenytoin
	Corticosteroids	Increase metabolism of steroids	Increase dose of steroids
	Dopamine	*Refer dopamine*	
	Isoniazid	*Refer isoniazid*	
	Oral contraceptives	*Refer contraceptives*	
	Quinidine	Enhanced quinidine metabolism	Increase dose of quinidine
	Rifamipicin	Enhanced phenytoin metabolism	Increase dose of phenytoin
	Sulphonamides	Inhibits phenytoin metabolism	Decrease dose of phenytoin

Drug A	Drug B	Effect	Comment
Phenytoin	Tetracyclines	Stimulates metabolism of tetracyclines	Increase dose of tetracycline
	Theophylline	Enhances theophylline metabolism	Increase dose of theophylline
Quinidine	Antacids	Decreases quinidine elimination	Decrease dose of quinidine
	Anticoagulants	Enhances hypoprothombinemic response	Monitor prothrombin time
	Barbiturates	Enhances metabolism of quinidine	Monitor for reduced effect of quinidine
	Cimetidine	Inhibits quinidine metabolism	Adjust dose of quinidine
	Digitalis	Reduces renal clearance of digitalis	Reduce dose of digitalis
	Phenytoin	*Refer phenytoin*	
	Rifamipicin	Stimulates metabolism of quinidine	Increase dose of quinidine
	Sodium bicarbonate	Decreases quinidine elimination	Decrease dose of quinidine
Rifampicin	Antidiabetic agents	Enhanced metabolism of antidiabetic agents	Increase dose of antidiabetic
	B-blockers	Enhanced metabolism of B blockers	Increase dose of B blockers
	Corticosteroids	Increased metabolism of steroids	Increase dose of steroids
	Digitalis	Increased metabolism of digitalis	Increase dose of digitalis
	Isoniazid	Increased metabolism of INH	Increase dose of INH

Drug A	Drug B	Effect	Comment
NSAIDS	Furosemide	*Refer furosemide*	
	Potassium sparing diuretics	Reduce renal function	Monitor renal function
	Thiazides	*Refer thiazides*	
Penicillins	Aminoglycoside	*Refer aminoglycosides*	
	Oral Contraceptives	*Refer contraceptives*	
	Probenecid	Reduced renal elimination of penicillins	Reduce dosage of penicillins
	Tetracyclines	Nullifies action of penicillins by bacterial inhibition	Avoid co-administration
Phenytoin	Chloramphenicol	*Refer chloramphenicol*	
	Cimetidine	Inhibits phenytoin metabolism	Decrease dose of phenytoin
	Corticosteroids	Increase metabolism of steroids	Increase dose of steroids
	Dopamine	*Refer dopamine*	
	Isoniazid	*Refer isoniazid*	
	Oral contraceptives	*Refer contraceptives*	
	Quinidine	Enhanced quinidine metabolism	Increase dose of quinidine
	Rifamipicin	Enhanced phenytoin metabolism	Increase dose of phenytoin
	Sulphonamides	Inhibits phenytoin metabolism	Decrease dose of phenytoin

Drug A	Drug B	Effect	Comment
Phenytoin	Tetracyclines	Stimulates metabolism of tetracyclines	Increase dose of tetracycline
	Theophylline	Enhances theophylline metabolism	Increase dose of theophylline
Quinidine	Antacids	Decreases quinidine elimination	Decrease dose of quinidine
	Anticoagulants	Enhances hypoprothombinemic response	Monitor prothrombin time
	Barbiturates	Enhances metabolism of quinidine	Monitor for reduced effect of quinidine
	Cimetidine	Inhibits quinidine metabolism	Adjust dose of quinidine
	Digitalis	Reduces renal clearance of digitalis	Reduce dose of digitalis
	Phenytoin	*Refer phenytoin*	
	Rifamipicin	Stimulates metabolism of quinidine	Increase dose of quinidine
	Sodium bicarbonate	Decreases quinidine elimination	Decrease dose of quinidine
Rifampicin	Antidiabetic agents	Enhanced metabolism of antidiabetic agents	Increase dose of antidiabetic
	B-blockers	Enhanced metabolism of B blockers	Increase dose of B blockers
	Corticosteroids	Increased metabolism of steroids	Increase dose of steroids
	Digitalis	Increased metabolism of digitalis	Increase dose of digitalis
	Isoniazid	Increased metabolism of INH	Increase dose of INH

Drug A	Drug B	Effect	Comment
Rifampicin	Oral contraceptives	Increased risk of unplanned pregnancy	Use other methods of birth control
	Phenytoin	*Refer phenytoin*	
	Quinidine	*Refer quinidine*	
	Theophylline	Enhanced metabolism of theophylline	Increase dose of theophylline
Salicylates	Alcohol	Enhanced risk of GI blood loss	Avoid combination
	Antacids	Increased renal elimination of aspirin	Increase dose of aspirin
	Antidiabetic agents	Enhanced response to antidiabetics	Reduce dose of antidiabetic
	Corticosteroids	Decreased level of Salicylates	
	Heparin	*Refer heparin*	
	Probenicd	Inhibits effect of probenicid	Avoid combination
Sodium Bicarbonate	Methenamines	Inhibits conversion of methanamine to active form	Select an alternative to either
	Quinidine	*Refer quinidine*	
	Sympathomimetics	Decreases elimination of sympathomimetics	Reduce dose of sympathomimetics
Spironolactone	Digitalis	Reduced elimination of digitalis	Watch for digitalis toxicity
	Potassium salts	Hyperkalemia	Monitor serum potassium

Drug A	Drug B	Effect	Comment
Sulphonamides	Antidiabetic agents	Increases activity of antidiabetics	Use another antibiotic if possible
	Digitalis	Reduced GI absoprtion of digitalis	Monitor for reduced effect of digitalis
	Phenytoin	*Refer phenytoin*	
Sulfonyl ureas	Alcohol	Antabuse like reaction	Warn patient
	B Blockers	Masks signs of hypoglycemias	
	Chloramphenicol	*Refer chloramophenicol*	
	Cimetidine	Increased effect of sulfonylureas	Reduce dose of sulfonylureas
	Thiazides	Aggravate diabetes	Use other hypotensive agent
	Rifampin	Increases metabolism of sulfonylurea	Increase dose of sulfonylurea
	Salicylates	Enhanced response to sulfonylureas	
	Sulfonamides	Decreases metabolism of sulfonylurea	Use other antibiotic.
Tetracyclines	Barbiturates	*Refer barbiturates*	
	Bismuth	Reduce GI absorption of tetra-tetracycline	Separate doses by 2 hrs with tetracyclinegiven first
	Carbamazepine	May stimulate doxycycline metabolism	Possible decrease in antimicrobial effect
	Iron preparations	Decreased tetracycline absorption probably due to chelation	Separate doses by 2 hrs
	Oral antacids	*Refer antacids*	

Drug A	Drug B	Effect	Comment
Tetracyclines	Oral contraceptives	*Refer contraceptives*	
	Penicillins	*Refer penicillins*	
	Phenytoin	Stimulates doxycycline metabolism	Decreasing antimicrobial effect
	Zinc salts	Large doses of zinc may decrease absorption of tetracycline	Space doses by 2 hrs or more and give tetracycline first
Theophylline	B blockers	*Refer B blocker*	
	Cimetidine	*Refer cimetidine*	
	Erythromycin	*Refer erythromycin*	
	Phenytoin	*Refer phenytoin*	
	Rifampicin	*Refer rifampicn*	
Thiazides	Antidiabetic agents	Aggravates diabetes	Use potassium sparing diuretic
	Digitalis	Digitalis intoxication due to potassium loss	Supplement potassium
	Lithium	Decreases elimination of lithium	Monitor plasma lithium levels
	NSAIDS	Inhibit natriuretic & anti-hypertensive effect of thiazides	Regulate dosage of thiazides
	Steroids	Enhancement of potassium depletion	Supplement potassium

Drug A	Drug B	Effect	Comment
Tolbutamide	Cimetidine	*Refer cimetidine*	
Verapamil	Digoxin	Increased plasma levels of digoxin	Adjust dose of digoxin

5 DRUG INDUCED DISORDERS

COMMON DRUGS ASSOCIATED WITH CHARACTERISTIC ERUPTIONS

Type of Eruption	Drug
Erythema multiforme	Penicillins, phenothiazines, sulfonamides, thiazides, chlorpropamide.
Erythema nodosum	Sulfonamides, oral contraceptives
Fixed	Barbiturates, phenolphthalein, quinidine,sulfonamide, gold tetracycline, phenacetin.
Lichen planus - like	Chloroquine, gold, thiazides, quinidine.
Purpuric	Barbiturates, chlorthiazide, gold, sulfonamides, quinidine, griseofulvin.
Bullous	bromides, phenophthalein, salicylates.

DRUGS CAUSING ALOPECIA

Cicatricial alopecia

- Quinacrine
- Para aminosalicyclic acid

Non cicatricial alopecia

- Cytostatic agents - cyclophosphamide, methotrexate, actinomycin, colchicine, doxorubicin, azothioprine
- Anticoagulants - heparin, coumarin
- Endocrine agents - thiouracil, carbimazole, bromocriptine
- Levodopa
- Antihypertensives - propranolol, potassium thiocyanate
- Butyrophenone (antipsychotic)
- Antiepileptic - trimethadione
- Others - bismuth compounds, thallium, mercurials, tripranol, chloroprene

DRUGS CAUSING HYPERTRICHOSIS

- Diphenyl hydantoin (common in females)
- Diazoxide (common in children)
- Minoxidil
- Streptomycin
- Penicillamine
- Danazol
- Systemic and topical steroids
- Psoralens
- Androgens

DRUG INDUCED RESPIRATORY DISORDERS

Type of disorder	Drugs commonly involved
1 Acute infiltration & eosinophilia	a. Nitrofurantoin
2. Interstitial pneumonia & fibrosis	a. Amiodarone b. Bleomycin c. Busulphan d.. Cyclophosphamide e. Methotrexate f. Nitrofurantoin
3. Lupus like syndromes	a. Hydralazine b. Phenytoin c. Procainamide
4. Asthma	a. Aspirin b. B - blockers c. Tartarazine d. Anaphylaxis due to any drug
5. Pulmonary embolism	a. Oral contraceptives
6. Respiratory depression	a. Alcohol b. Antidepressants c. Antihistamines d. Benzodiazepenes e. Chloral derivatives f. Opiate analgesics

DRUGS WHICH CAN CAUSE HEMOLYTIC ANEMIA

1. Immune mechanisms

- Pencillins & Cephalosporins
- Quinidine
- Quinine
- Stibophen
- Sulphonamides

2. Autoimmune process

- L Dopa
- Mefanamic acid
- Methyl dopa
- Phenacetin

3. In association with G6PD deficiency

a. Drugs with most marked effect

- Nitrofurantoin
- Phenacetin
- Primaquine
- Probenecid
- Sulphonamides (sulphafurazole, sulphanilamide, sulphapyridine, sulphasalazine)

b. Other commonly used drugs

- Analgesics - antipyrines, salicylates
- Antimalarials - chloroquine

DRUGS WHICH CAN CAUSE PANCYTOPENIA

1. Cytotoxic agents

2. Antibiotics

- Chloramphenicol
- Sulphonamides
- Streptomycin
- Isoniazid

3. Anticonvulsants

- Hydantoins
- Succinimides
- Primidone
- Troxidone

4. Antimalarials

- Pyrimethamine

5. Hypoglycaemic agents

- Tolbutamide
- Chlorpropamide

6. Antithyroid drugs

- Thiouracils
- Carbimazole
- Potassium perchlorate

7. Antirheumatic agents

- Phenyl butazone& oxyphen butazone
- Gold salts
- Penicillamine
- Colchicine
- Indomethacin

8. Psychotropic drugs

- Meprobamate
- Phenothiazines
- Tricyclic antidepresants

9. Others

- Acetozolamide

DRUGS WHICH CAN CAUSE SELECTIVE NEUTROPENIA

- Amodiaquine
- Antihistamines
- Captopril
- Metronidazole
- Paraminosalicylic acid
- Phenindone
- Sulphasalazine
- Thiacetazone

All the above can also cause pancytoppenia

DRUGS WHICH CAN CAUSE SELECTIVE THROMBOCYTOPENIA

- Carbamazepine
- Chloroquine
- Digitoxin
- Mepacrine
- Meprobromate
- Methyl dopa
- Quinidine
- Quinine
- Rifampin
- Salicylates
- Tetracyclines
- Thiazides

DRUGS WHICH MAY COLOUR URINE

Drug	Colour
Adriamycin	Red
Chloroquine	Rust yellow to brown
Clofazimine	Red to brownish black
Ferrous salts	Black
Indomethacin	Green (due to hyperbiliveridinemia)
Levodopa	Dark on standing on hypochlorite solution (toilet bleach)
Methyldopa	Dark on standing on hypochlorite solution (toilet bleach)
Metronidazole	Dark
Nitrofurantoin	Rust yellow to brown.
Phenacetin	Dark brown to black on standing
Phenothiazines	Pink to red or red brown
Primaquine	Rust yellow to brown
Quinine	Brown to black
Riboflavin	Yellow flourescence
Rifampin	Bright red - orange
Sulphonamides	Rust yellow to brown

DRUG INDUCED LIVER DISORDERS

1. Drugs causing direct toxicity

- Acetaminophen
- Aspirin
- Alcohol
- Carbon tetrachloride
- Heavy metals
- Methotrexate
- Phosphorus

2. Drugs causing altered metabolism

- Androgens
- Corticosteroids
- Estrogen
- Ethanol
- Tetracycline(IV)

DRUGS CAUSING IMMUNE MEDIATED DESTRUCTION OF THE LIVER

1. Viral hepatitis like

- Halothane
- Isoniazid
- Oxacillin
- Phenytoin
- Sulfonamides
- Valproic acid

2. Granulomatous hepatitis

- Allopurinol
- Hydralazine
- Phenylbutazone
- Phenytoin
- Quinidine
- Sulfa drugs

3. Inflammatory cholestasis

- Chlorpromazine
- Chlorpropamide
- Erythromycin estolate
- Propylthiouracil
- Thiazides

4. Chronic active hepatitis

- Acetaminophen
- Aspirin
- Isoniazid
- Methyldopa
- Nitofurantoin
- Oxyphenisatin

IV

Bedside Manoeuvres

1 AIRWAY MANAGEMENT

Control of airway with bag and mask

Indications: Cardiopulmonary failure, respiratory failure and stridor.

Procedure

Position: Patient supine with the head elevated on a thin pillow.

1. Open the jaw widely . Remove dentures, if any and clear the airway.

2. Select a mask which covers the mouth and nose and forms a firm seal.

   In edentulous patients, a good seal may be achieved by filling out the cheeks with gauze balls placed in them.

3. Ventilate at a rate of 10 - 15 / minute with an inspiratory expiratory ratio of 0.5.

4. Look for movement of the chest and the absence of movement of the upper abdomen.

5. Repeat until adequate oxygenation is achieved and an airway establised.

Cricothyrotomy

Indications: Upper airway obstruction (foreign body, laryngeal edema) and emergency airway access.

Contraindications: Trauma to the larynx or cricoid cartilage.

Procedure

Position: Patient supine with the neck extended.

1. Palpate the cricothyroid space. This is the first depression below the thyroid cartilage in the midline.

2. Infiltrate the skin with 1% lidocaine without epinephrine.

3. Make a 1.5 cm transverse incision directly through the skin over the cricothyroid membrane so that the wound gapes. This indicates that the platysma has been cut.

4. Slide the left index finger into the incision. Rest the fingernail on the cricothyroid membrane. Slide the blade along the finger. Puncture the membrane and twist the blade to enlarge the opening.

5. With finger insitu, withdraw the scalpel; insert a curved hemostat; enlarge the opening and insert the tracheostomy tube between the blades of the hemostat.

6. Fix the tube and place gauze under it.

Identifying the cricothyroid space is an essential manouevre. Making the incision into the thyroid cartilage will not only damage it but also injure the vocal cords. Insertion of the scalpel too far, especially in a moving patient, could damage the structures of the larynx.

Endotracheal Intubation

Indications: Airway maintenance, cardiorespiratory failure, severe airway obstruction, superficial airway burns and to prevent aspiration of gastric contents.

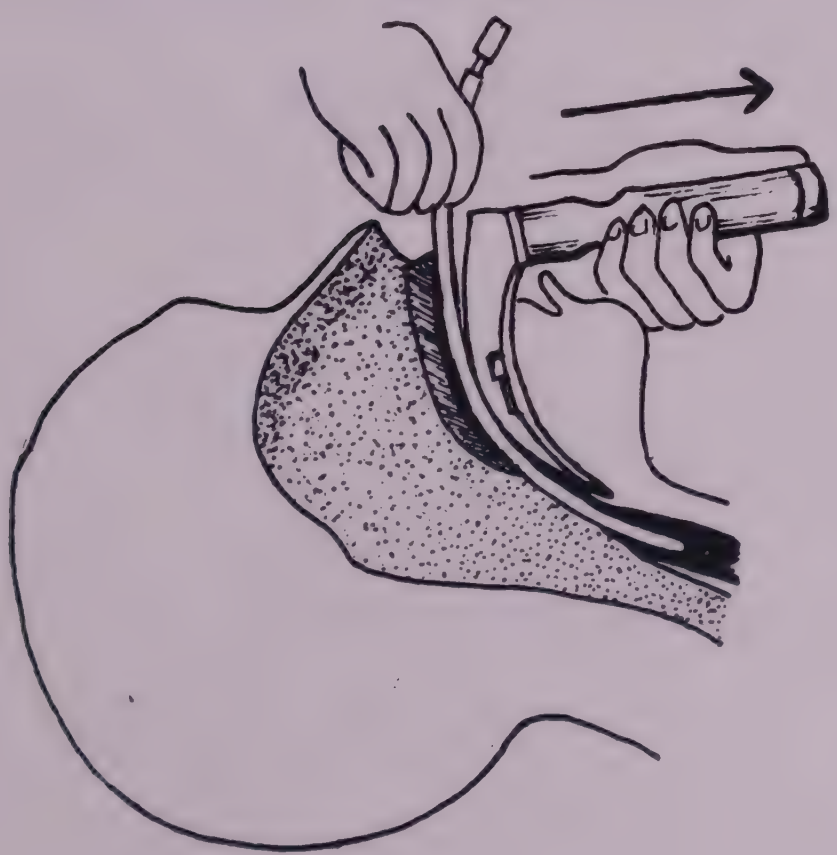
Contraindications: Hypoxia and known cervical spine injury.

Procedure

Position: Patient supine with the neck extended. The mouth and the glottis must lie along a straight line.

1. Ventilate with a bag and mask if necessary.

fig 1. Endotracheal intubation



2. Insert a laryngoscope with the left hand into the right side of mouth and move it to the centre pushing the tongue to the left.

3. Pull the laryngoscope downwards and visualize the glottic folds. Slide the endotracheal tube between the vocal cords upto 2 cms below them.

Apply pressure over the cricoid cartilage. This prevents aspiration of gastric contents.

4. Inflate the endotracheal tube cuff.

5. Auscultate to ensure bilateral, equal air entry.

It may be necessary to secure muscle relaxation in some cases. Do not administer muscle relaxants unless skilled assistance is at hand.

Complications: Trauma to oral cavity, vomiting, aspiration and esophageal/ bronchial intubation.

2

VASCULAR ACCESS

Central Venous Pressure Monitoring

Indications: Suspicion of biventricular failure when pulmonary artery monitoring is not available, suspicion of cor pulmonale, cardiac tamponade and management of fluid resuscitation.

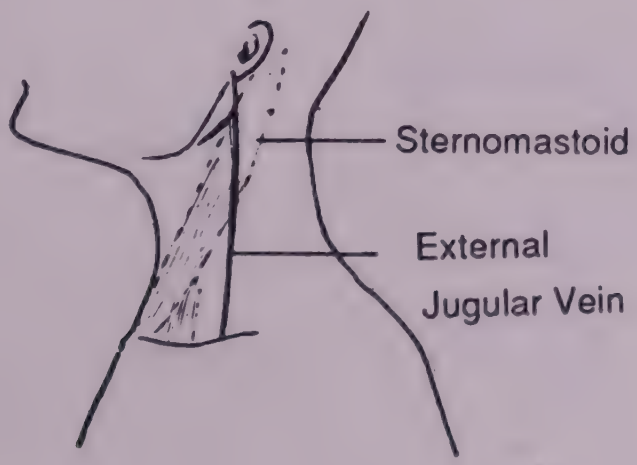
Contraindications: Uncomplicated hypovolemia is a relative contraindication.

Procedure

1. A catheter in a central position (subclavian or internal jugular line) is necessary for CVP determination.

2. The fluid infusion is temporarily halted and a three way stopcock is inserted between the intravenous tubing and the catheter. A water manometer tube is attached to the free arm of the stopcock.

fig 2. Central venous Access



3. The exact reference point for the measurement is determined by levelling the sternal prominence at the angle of Louis, with the 5 cms mark on the manometer (since the right atrium is assumed to be approximately 5 cms posterior to the sternal angle). The same method should be used throughout the care of a specific patient.

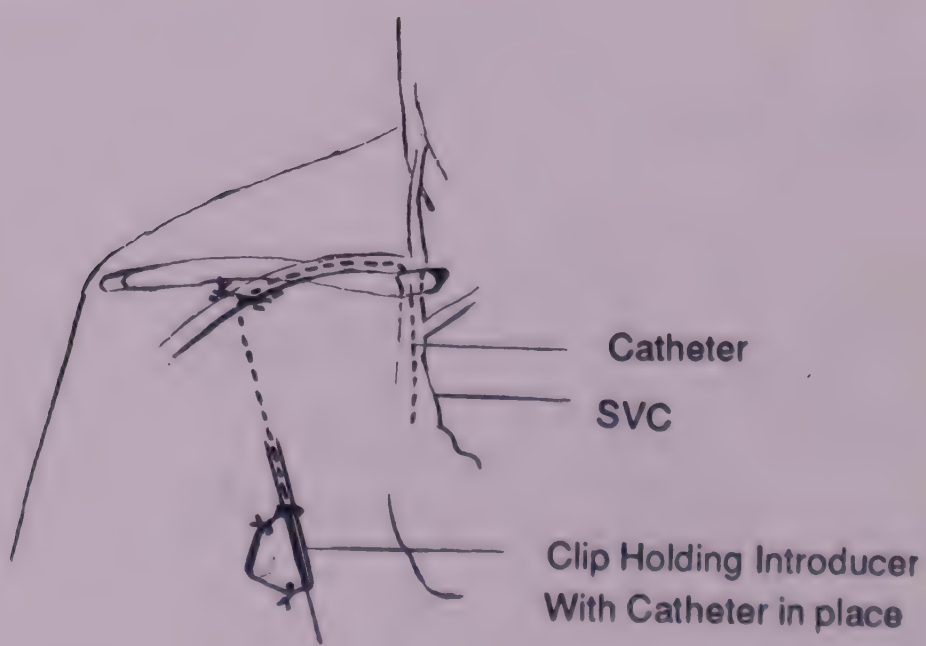
4. Thus standardized, the manometer is filled with fluid by closing the stopcock and diverting the infusion into it. The stopcock is then turned off to the intravenous bottle, thus establishing continuity between the patient and the manometer tube. The meniscus will slowly fall until it reaches a level reflecting the CVP.

5. The CVP measured in centimeters of water is accepted if the following criteria are met:

a. Free flow of the intravenous infusion through the CVP line and/or demonstration of the free return of blood through the catheter

b. Intra thoracic catheter tip position (ideally in the superior vena cava) is confirmed by a chest film

fig 3. Subclavian Catheterization



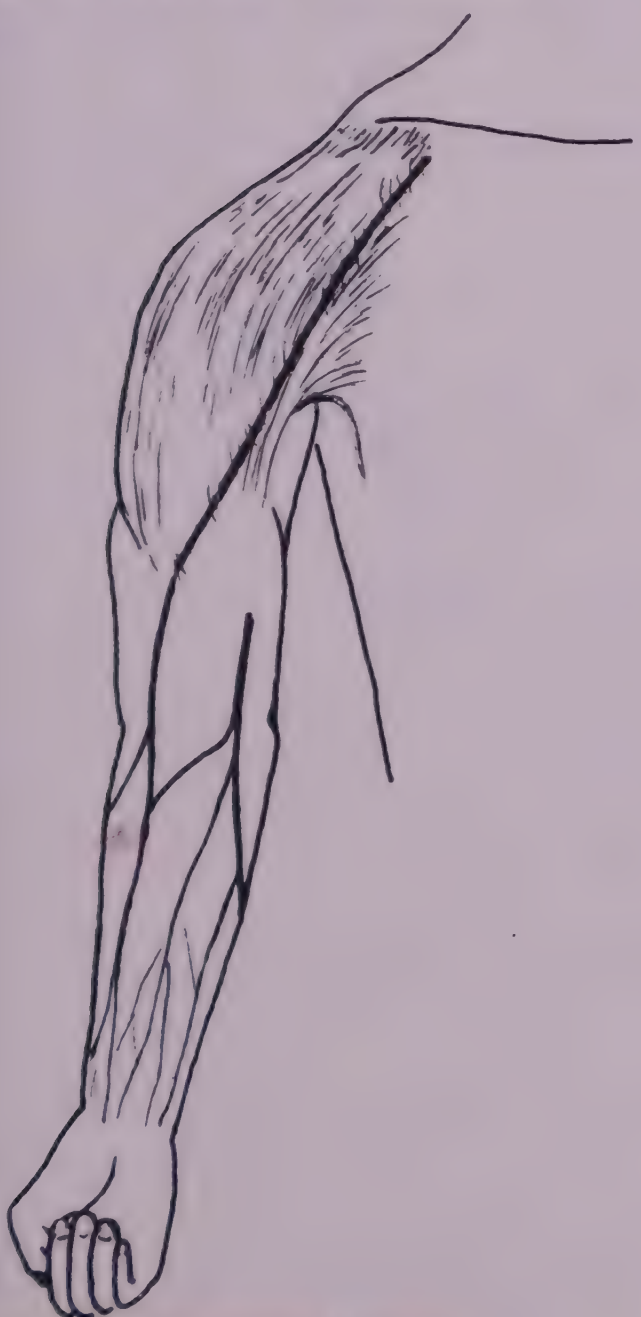
c. Respiratory variation of meniscus during the measurements is seen.

Complications: Clotting, damping due to viscosity, sludging in the lumen if blood products are used and respirator settings that obscure the actual manometric reading are the main complications.

Venous Access

Vein selection: The median cubital vein is commonly used. Alternatively the median basilic vein in the forearm, the saphenous vein over the ankle and the femoral vein in the groin may be used.

fig 4. Veins of the upper extremity

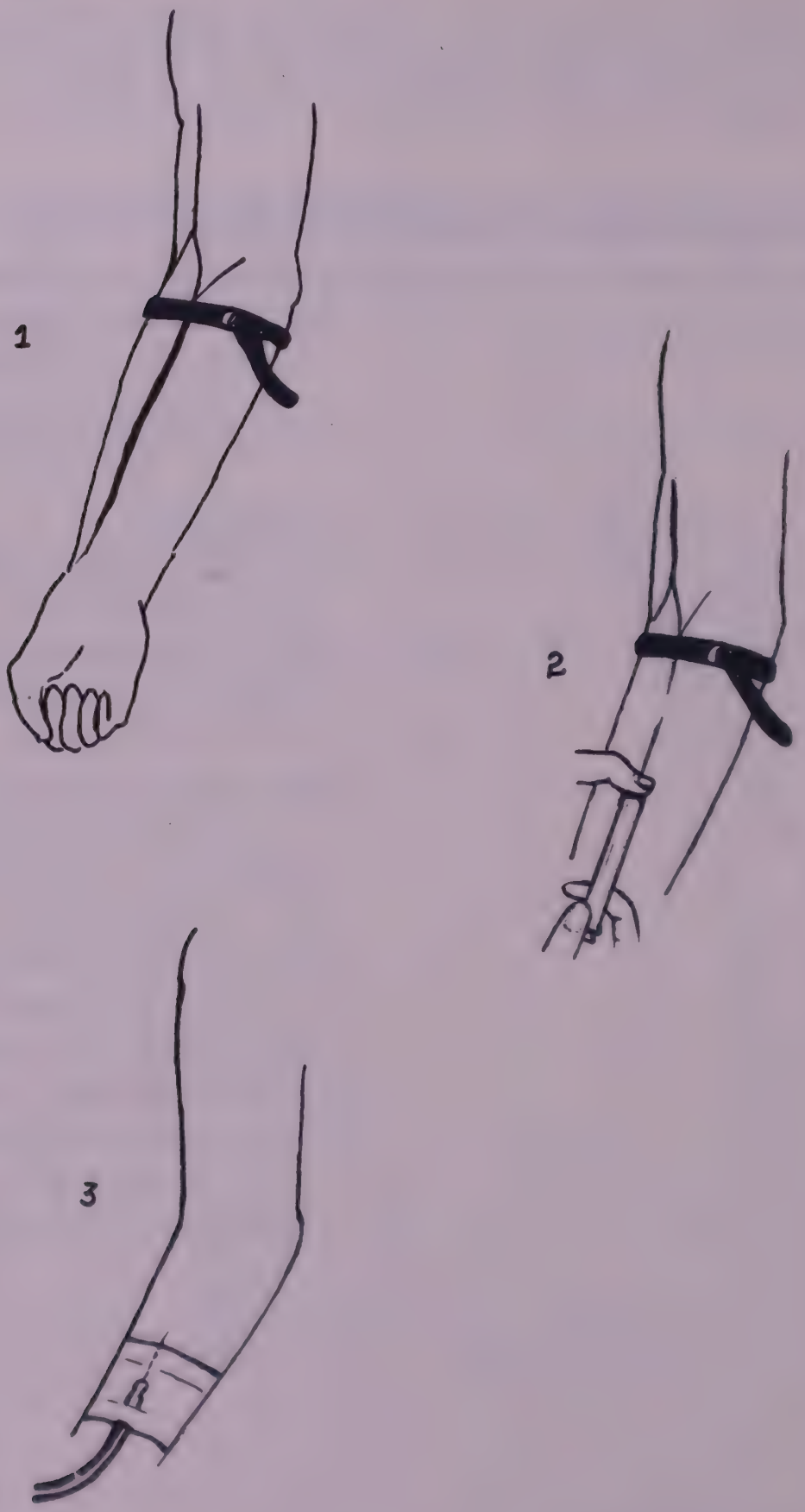


Procedure

1. Apply pressure proximally on the extremity so as to impede venous drainage and not arterial flow, while the patient clenches his/her fist.

2. The puncture site is well cleansed with antiseptic and the needle, with the bevelled edge up, is introduced into the dermis, advancing slowly into the vein. The flash back of blood into the hub of the syringe indicates successful cannulation. The needle is advanced slowly in the direction of the vein by gently lifting up the vein .

fig 5. Venous access



3. Connect the needle to an infusion set after drawing blood. If the needle is to be removed, withdraw and a place sterile gauze over the site for 2-3 minutes.

Presence of pulsations , spontaneous filling of the syringe, and /or bright red blood in the syringe indicates an arterial puncture.

Venesection

Indications: When anticubital veins cannot be visualized; for placement of a central line through the basilic or median veins and as a short line for rapid fluid replacement.

Vein Selection: The median basilic, median, cephalic and external jugular veins and the origin of the saphenous vein in the ankle are the commonly used sites.

Procedure

Position: Patient supine.

1. Apply a tourniquet proximally before the procedure to help visualize the vein. It should not be left on during the procedure since it will cause excessive bleeding from the cut down site.

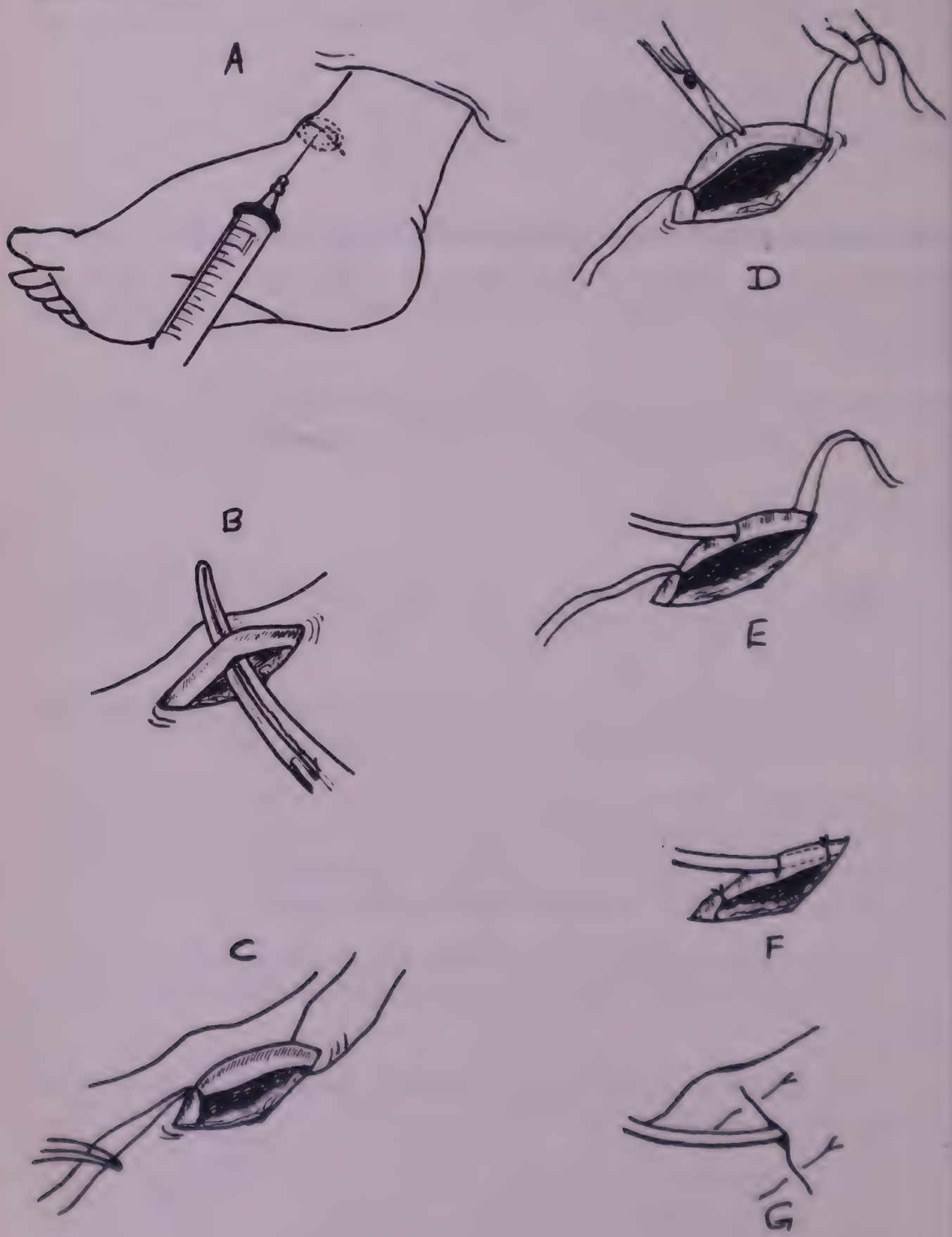
2. A wide sterile field extending proximally and distally for 8-10 cms from the site is prepared. 1% lignocaine is infiltrated into this area.

3. An incision transverse to the axis of the vein is made and extended through the skin till the subcutaneous tissue is free. The loose areolar tissue is dissected aside and the vein is identified as a pulseless thin walled vessel whose blue colour blanches when distal traction is applied.

4. The vein is dissected free for a distance of 4 cms along its axis. Two fine ties are passed around the vein; the distal one is secured and the proximal one left free.

5. Pierce the midsection of the vein with #11 scalpel blade and dilate the venotomy with a hemostat.

fig 6. Venesection



6. The catheter tip is inserted and gently advanced. The wire stylet is removed and the catheter is connected to an intravenous solution. Flush the catheter with 5-10 mL saline before attaching the infusion tube.

7. Once the catheter is in place and the infusion is running freely, the proximal tie is secured around the vein without occluding the catheter. The skin incision is closed with interrupted simple sutures using 4-0 silk.

8. Stabilise the catheter with a board after taping and securing the wound.

Complications: Vasospasm, infection, phlebitis and hematoma.

The proper length for a central line placed through a cut down of the basilic vein can be determined by measuring the distance from the incision to the supra sternal notch when the arm is fully abducted. When the line is in place the tip will lie in the superior vena cava.

3 ASPIRATIONS AND DRAINAGE PROCEDURES

Transtracheal Aspiration

Indications: To stimulate cough in patients with a poor cough reflex; to obtain an uncontaminated sputum specimen.

Contraindications: Bleeding diathesis, uncontrollable cough, unresolved hypoxemia and an uncooperative patient

Procedure

Position: Patient supine, with the neck extended.

1. Infiltrate the skin and the subcutaneous tissue down to the cricothyroid membrane with a local anaesthetic.

2. Puncture the cricothyroid membrane using #14 gauge needle with the bevel up; aim the needle caudally at a 45 degree angle to the skin.

3. Aspirate to confirm its position (free flow of air is characteristic).

4. Thread a catheter into the trachea through the needle.

5. Remove the catheter stylet and slide the needle out over the catheter. Tape the catheter in place.

6. Aspirate sputum, by attaching a 10 ml syringe to the cannula during a voluntary cough.

If the sputum volume is inadequate or the cough is not well stimulated inject 2-3 mL sterile saline and aspirate again.

7. Remove the syringe, withdraw the catheter and apply a dressing.

Complications: Hemoptysis, subcutaneous or mediastinal emphysema, cardiac dysrrythmias and catheter aspiration.

Thoracocentesis.

Indications: Hydrothorax, hemothorax, stable pneumothorax, empyema.

Contraindications: Anticoagulant therapy, pneumonias

Procedure

Position: Patient seated sideways on a chair with the arms draped over a pillow. If air in the pleural space is expected, the patient is made to lie supine with the hand behind the head.

1. Check the height of the fluid level with a chest film and by percussion.

2. Advance a #22 gauge needle and syringe with local anaesthetic, off the top of the rib border until it is free and advances towards the pleura. Small amounts of anaesthetic are placed. Aspiration of air or fluid indicates entry into the pleural cavity. Withdraw the needle until no aspirate is got, and inject the anaesthetic at this point.

fig 7. Thoracocentesis

3. Advance a large needle with a small syringe attached to it, into the pleural space. Aspirate for material. Remove the syringe and advance a catheter through the needle and remove the needle over the catheter. Attach a stop-cock to the catheter hub. Pleural contents are withdrawn using a large syringe.

Complications: Pneumothorax, lung injury, injury to abdominal organs, empyema and hemorrhage if the intercostal or internal mammary vessels are injured.

Chest Tube Insertion

Indications: Spontaneous or traumatic pneumothorax, hydrothorax, hemothorax

Contraindications: Systemic anticoagulant therapy, empyema caused by acid fast organisms, small or loculated pneumothorax

Procedure

Position Patient supine with the hand behind the head.

Site. The 5th or 6th intercostal space lateral to the nipple.

1. Inject about 10 ml of a local anaesthetic immediately exterior to the pleural surface (refer Thoracocentesis).

2. Select a smaller (#18-20) for air drainage & a larger (#28-32) Malecots catheter for draining fluid collections.

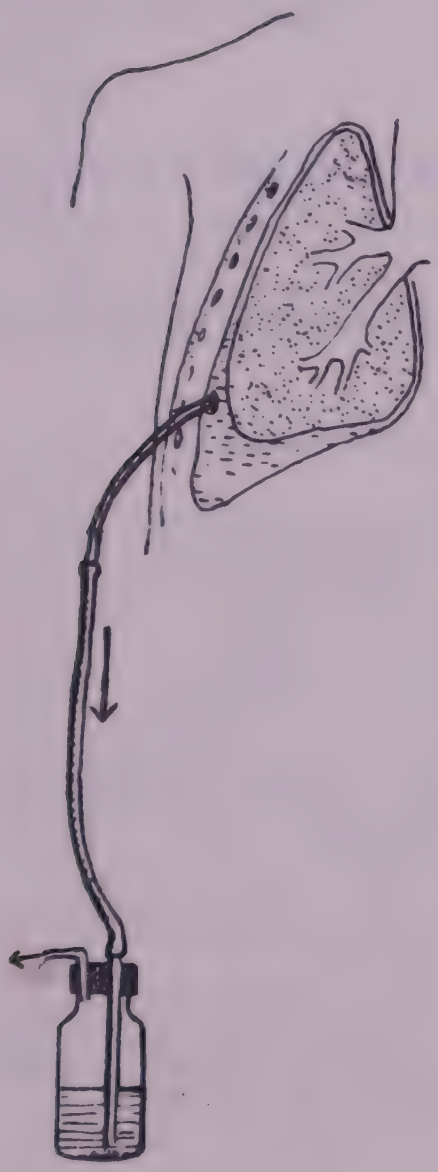
3. Make a 1.5 cms transverse incision over the selected space. Insert a hemostat, widen the incision and enter the pleural space. Insert the catheter as shown in fig. The patient should hold his breath in full inspiration. Direct the tube anteriorly for air collections and posteriorly for fluid collections. Suture tube in place with a non absorbable suture material.

4. Connect tube to a water seal.

5. Functioning of the tube can be ascertained by looking for oscillations of the fluid column in the tube with respiration.

Complications: Injury to the heart and great vessels, subdiaphragmatic placement of the tube, open pneumothorax, unexplained air leakage, tension pneumothorax, dislodgement of the tube, subcutaneous emphysema.

fig 8. Closed drainage of pleural space



Pericardiocentesis

Indications

Diagnostic. For patients with pericardial effusion of unknown origin

Therapeutic. Cardiac tamponade, malignant pericardial effusion, traumatic hemopericardium, ruptured thoracic aortic aneurysm.

Contraindications: Systemic anticoagulation

Procedure.

Position: Patient supine with the head and torso elevated at 30 degrees. ECG leads and nasal oxygen in place.

1. Infiltrate with a local anesthetic, an area from a point 2 cms below and 1 cm to the left of the xiphoid process, to the left costal margin.

2. Attach a 10 ml syringe to a plastic catheter over a needle and advance it to the left costal margin. Walk off it internally and direct the needle to the middle of the left scapula advancing 0.5 cm at a time, aspirating constantly.

3. Once fluid is aspirated from the pericardium (about 3 inches from the puncture site), advance the unit by 1 cm and remove the needle. Aspirate with a large syringe connected to the catheter through a 3 way stop cock. Aspiration is continued till satisfactory hemodynamic compensation is achieved.

Complications: Ventricular fibrillations, ventricular perforations, pneumothorax and peritoneal penetration.

If there is doubt about the origin of blood aspirated, it can be verified as follows. Blood that has been in the pericardial sac for 10 minutes or more is usually defibrinated and will therefore, fail to clot in an activated clotting time tube. Also the hematocrit of the fluid in the pericardium will be less than the patient's hematocrit.

Abdominal Paracentesis

Indications

Diagnostic: Peritonitis of uncertain etiology, suspected pancreatic and chylous or malignant ascites.

Therapeutic: Massive ascites causing respiratory embarassment.

Contraindications.: Distended loops of bowel on an abdominal film, known peritoneal adhesions, obvious surgical pathology requiring laprotomy and multiple previous abdominal incisions.

Procedure

Position: Patient supine.
Site: The safest site for an abdominal tap is either the right or left lower quadrant anteriorly just lateral to the margin of the rectus muscle.

1. Obtain films of the abdomen to rule out distended bowel loops or free air.

2. Anesthetise the skin with 1% lidocaine. A spinal needle (#18) is advanced bimanually with the stylet in place. Entry into the peritoneal cavity is detected by a sudden decrease in the force needed to advance the needle.

3. Remove the stylet and withdraw the fluid with a syringe to confirm its position within the peritoneal cavity.

4. If a large therapeutic tap is indicated remove the syringe and replace it with a preassembled stopcock apparatus for continuous aspiration.

Complications: Injury to the bladder or other viscera and peritonitis.

Urethral catheterization

Indications: Urinary retention, gross haematuria with clots, sterile urine collection for culture and intermittent catheterization in neurogenic bladder.

Contraindications: Acute prostatitis or epididymitis and a pelvic fracture with blood at the urethral meatus.

Procedure

In the male:

1. Prepare the glans- retract the foreskin if necessary. Lubricate the catheter tip. Inject lidocaine jelly into the meatus. Introduce the catheter into the meatus and advance it until urine flows freely.

fig 9. Foley's catheter in position

2. If a Foley's catheter is used, advance it slightly and inflate the balloon with sterile saline. Withdraw the catheter gently to seat the balloon against the bladder neck. Connect the catheter to a drainage bag and secure it.

If pain is encountered while inflating the retaining balloon, the catheter may be in the prostatic urethra. Deflate and reposition the catheter.

In the female:

1. Prepare the perineum and the vaginal introitus with an antiseptic solution.

2. Expose the urethral meatus by spreading the labia. Lubricate the catheter tip and introduce it into meatus.

3. Advance the catheter to about half way. The rest of the procedure is as above.

Complications: Urethral obstruction, traumatic catheterization, hematuria sepsis and urethral stricture.

Never force a catheter in attempting to bypass an obstruction.

Nasogastric (NG) Tube Insertion

Indications: Trauma involving the trunk, to remove recently ingested toxic substances, when intestinal obstruction is known or suspected; paralytic ileus, peritonitis, protracted vomiting; when gastrointestinal intestinal hemorrhage is suspected or known and before or after a recent endotracheal intubation

Contraindications: Complete obstruction of the nasopharynx, suspected cervical spinal cord injury, major facial trauma and the presence of a functioning gastrostomy tube

Procedure

Position: Patient seated upright or semireclining with the neck slightly flexed.

1. Note the distance from the xiphoid to top of patient's head on the tube.

2. Lubricate the distal 3 inches of the NG tube. Ask the patient to breathe through the mouth, and introduce the tip of the NG tube into the wider nostril; slowly advance the tube straight back into the posterior nasopharynx.

3. Advance the tube while asking the patient to swallow repeatedly until the previously noted marker is at the level of the nose.

4. Check the position of the tube by aspiration and/or injecting 20 mL of air into the stomach while listening for a bubbling sound over the epigastrium with a stethoscope. Affix tube in place with adhesive tape.

Complications: Excessive gagging, complete nasal obstruction, epistaxis, failure to drain properly due to improper positioning of the tube in the stomach. Prolonged intubation can lead to gastric erosion, otitis media due to obstruction of the eustachian tube and ulceration of nasal alae due to pressure necrosis.

4 OTHER PROCEDURES

Lumbar puncture

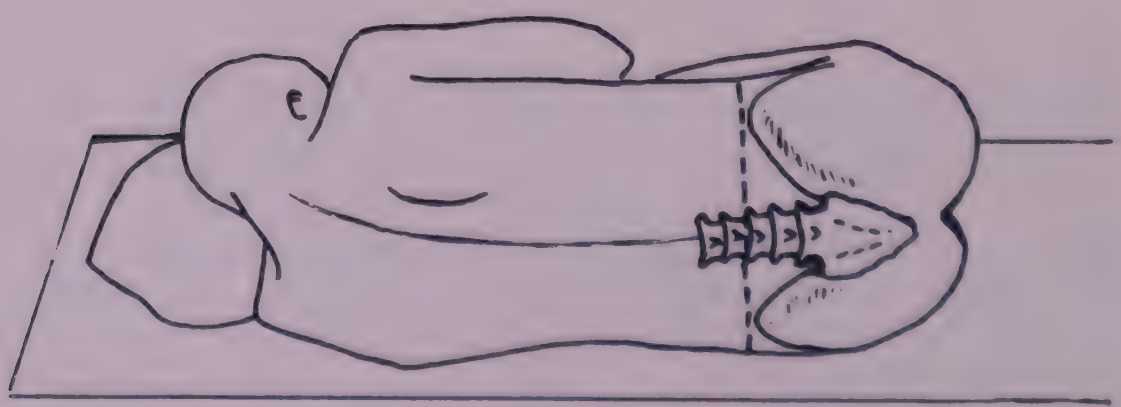
Indications

Diagnostic. Clinical suspicion of meningeal and intracranial infections,intracranial hemorrhage, febrile patients with seizures, autoimmune and malignant diseases involving the central nervous system.

Therapeutic. Compensated adult hydrocephalus, pseudo tumour cerebri, intrathecal chemotherapy and myelography.

Contraindications. Bleeding diathesis, papilledema or an intracranial mass, soft tissue infections in the lumbar region, spinal tumours, AV malformations and vertebral deformities.

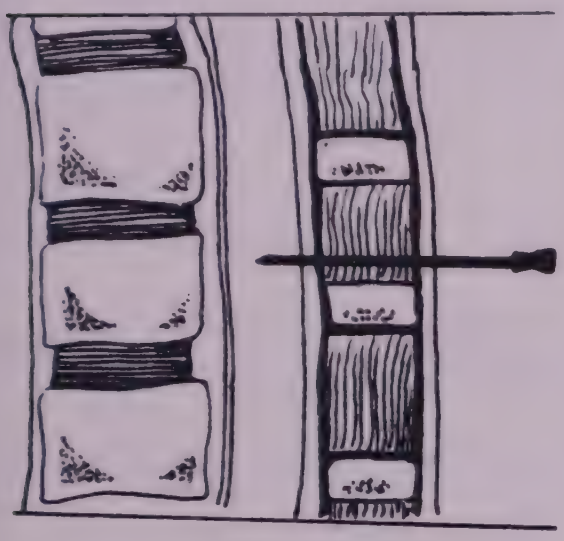
fig 10. Correct position for lumbar puncture



Procedure

Position: Patient is put on the lateral recumbent position, with the head flexed and the knees up on a firm flat surface.

fig 11. LP needle in the third lumbar space



Site: The third or fourth lumbar intervertebral space (roughly on a line joining the highest points of the iliac crests) is preferred. A sterile field is provided.

1. The subcutaneous and deeper tissues are infiltrated with 12 mL of lidocaine. The area is massaged to facilitate diffusion of the anaesthetic.

2. A puncture needle with stylet is inserted into the interspace in the midline along the mid-sagittal plane. The spinous process above is fixed with a thumb. This aids in guiding the needle.

3. Advance the needle by about 1-2 inches slowly till a give or a pop is felt as the needle enters the subarachnoid space. Remove the stylet and check for the emergence of fluid. If no fluid is seen repeat the procedure.

4. When fluid is obtained a manometer and stopcock are attached. The initial pressure is recorded. 2-3 mL of fluid is obtained for cell count, cytology, bacteriology and biochemistry.

5. A closing pressure is recorded; the stylet is reinserted and the needle is withdrawn.

It is recommended that the patient rests in a prone or supine position with the head down for 1-4 hours to minimise the risk of lumbar puncture headache.

Complications: Potential CSF leak due to high pressure, a traumatic tap, lumbarpuncture headache, herniation of brainstem in cases of raised intracranial tension, infection.

Peritoneal lavage

Indications: Multiple trauma with concomitant blunt abdominal trauma, the unconscious patient with potentially significant blunt abdominal trauma, suspected blunt abdominal trauma in patients with concomitant spinal injuries, suspected third space losses, alcoholics and drug addicts.

Contraindications: Obvious penetrating abdominal trauma, free air in the peritoneal cavity on a plain film, massively distended loops of bowel on a plain film, pelvic injuries, pregnancy, previous lower abdominal surgery or known peritoneal adhesions and abdominal paracentesis.

Procedure

Position:. Patient supine.

1. Prepare the lower abdomen. Catheterize the bladder. Infiltrate 1% lidocaine in the midline, 1/3rd of the distance between the umbilicus and the pubis.

2. Make an infraumbilical, vertical incision (2-4 cms). Expose and elevate the peritoneum by gentle traction.

3. Insert the dialysis catheter 1cm into the peritoneal cavity. After withdrawing the trocar, advance the catheter to half its length (all the holes must be inside the peritoneum) towards the side of greatest clinical suspicion.

4. Aspirate. If blood, bile or bowel contents are aspirated the test is positive and the catheter is removed. If nondiagnostic, infuse one litre of Ringer's lactate solution. Suture the fixation device to the skin.

5. Disperse the fluid in the peritoneum by rolling the patient from side to side. Siphon out the fluid when the dispersal has been completed. This is done by placing the solution bag below the patient's bed.

A peritoneal lavage is positve when:

1. The initial aspirate contains blood, bile or bowel contents.

2. The lavage fluid contains one or more of the following: RBCs >100,000/ cumm, WBCs > 500/ cu mm, amylase > 175 units /100 ml (or if the amylase concentration of fluid is greater than serum amylase) and if the hematocrit of fluid is >2%.

Complications: Perforation of a hollow viscus, intraperitoneal bleeding, bleeding from the incision, pneumoperitoneum, peritonitis.

Gastric Lavage

Indications: Upper gastrointestinal hemorrhage, removal of toxins and removal of particulate matter not removed by nasogastric intubation.

Contraindications: Esophageal stricture or obstruction, oro-facial trauma and cervical spinal cord injuries.

Procedure

Position: Patient sitting erect or semireclining.

1. The procedure is similar to nasogastric intubation tube except that the lavage tube is passed orally due to the greater calibre of the tube.

2. Topically anesthetize the oropharynx to avoid excessive gagging. Extra holes are created near the tip of the lavage tube to facilitate removal of particulate matter or clotted blood.

3. Check the position of tube by aspiration. Instill 100-200 mL of lavage fluid by catheter tip syringes. Aspirate with a syringe or a teat. Repeat the procedure till the aspirate is clear.

Complications: Aspiration of gastric contents, bleeding from laceration of pharyngeal mucosa, choking.

Appendix

DRUG DOSING IN RENAL IMPAIRMENT

GUIDELINES FOR DRUG DOSING IN RENAL FAILURE

1. Drugs which have a low toxic potential or a wide therapeutic index do not require dose adjustments in renal failure (eg. penicillin G). Doses of drugs with a narrow therapeutic index and high toxic potential (gentamicin) must be carefully adjusted if they are excreted by the kidney.

2. The loading dose need not be changed for most commonly used therapeutic agents.

3, Monitor the patient *clinically* for evidence of toxicity.

4. Nomograms for calculating drug doses should not be used :

- if there is fluctuating renal function
- if the drug does not obey first order kinetics
- if the patient is on dialysis
- in children

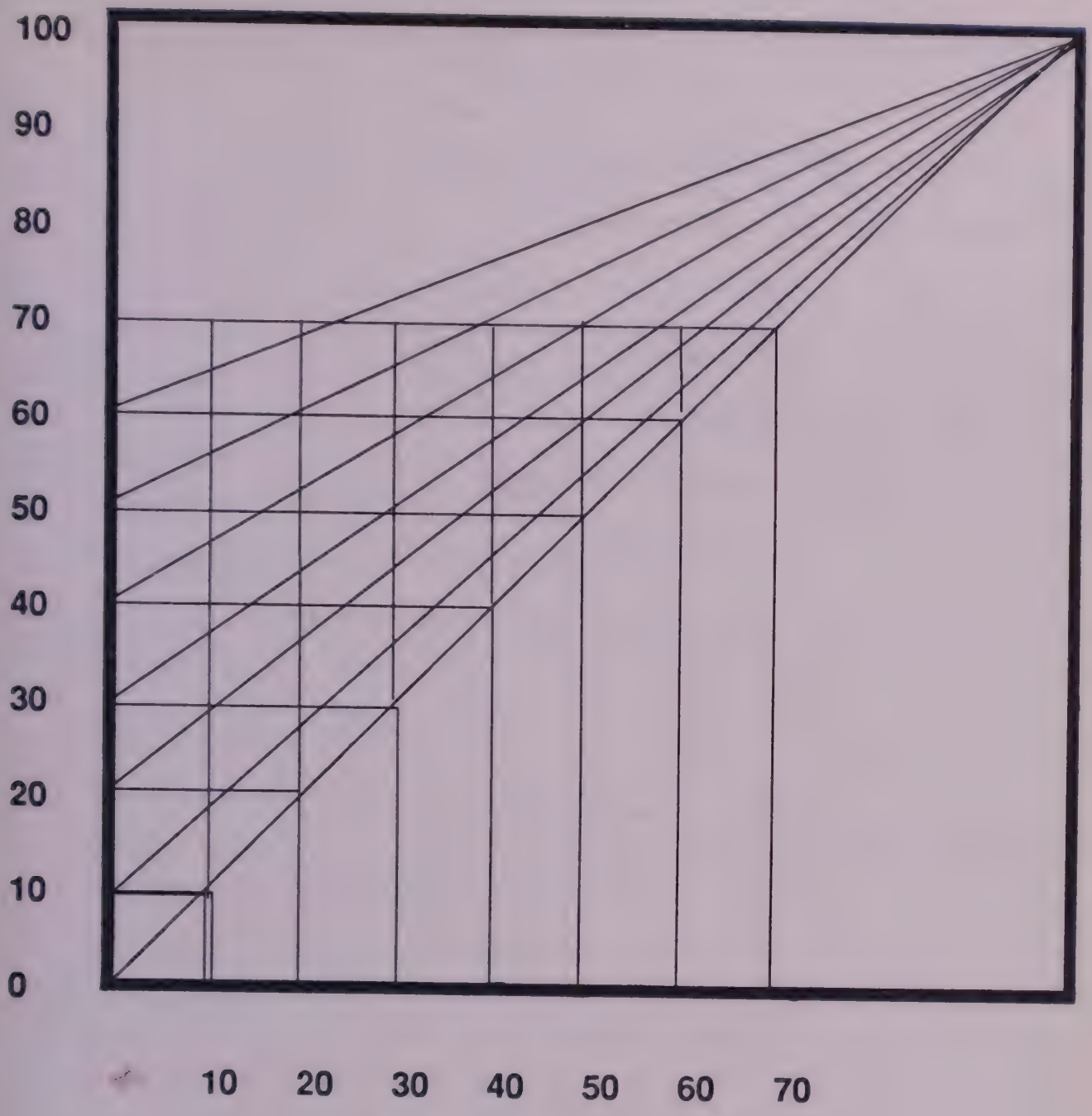
5. Monitor plasma levels :

- in fluctuating renal function
- in patients undergoing dialysis
- when the therapeutic index is too narrow
- when the drug has non linear or unpredictable kinetics

Percentage Non renal elimination of drugs

Group A >90% renal		GroupB 50-80% renal		GroupC <50% renal	
Drug	%	Drug	%	Drug	%
Amikacin	5	Dicloxacillin	50	AmphotericinB	70
Amoxicillin	10	Erythromycin	35	Chloramphenicol	80
Ampicillin	10	Ethambutol	50	Clindamycin	100
Carbenicillin	10	Isoniazid*	50	Doxycycline	80
Cefazolin	5	Lincomycin	40	Isoniazid#	80
Cephalexin	5	Nafcillin	40	Minocycline	100
Cephalothin	5	Oxacillin	25	Rifampin	100
Colistin	10	Oxytetracycline	20	Sulfamethoxazole	85
Flucytosine	5	Trimethoprim	50	Digitoxin	100
Kanamycin	5	Digoxin	30	Lidocaine	95
Methicillin	10	Disopyramide	40	Phenobarbital	70
Penicillin G	10	Procainamide	30	Quinidine	65
Polymyxin B	10			Theophylline	100
Steptomycin	5				
Tetracycline	10				
Ticarcillin	10				
Tobramycin	5				
Vancomycin	5				
Lithium	0				

- Fast acetylators; * - Slow acetylators



X axis - Creatinine clearance (mL/min)

Y axis - Drug clearance % Normal

Nomogram for estimating drug dose in renal failure.

How to use the nomogram: *Read off the % of non renal clearence of the drug. The value of the ordinate intersecting this line at the given creatinine clearence is the % of the drug to be used. . Calculate creatinine clearence using the formula given in the next page* (J.of clinical pharmacokinetics; 1976).

Formula for estimating creatinine clearance in patients with stable renal function.

Cl cr (males) = (140 - age) x (weight)/Cr s x 72

Cl cr (females) = 0.85 x above value.

where,

Cl cr is the creatinine clearance

Cr s is the serum creatinine

age is in years and weight is in kilograms

THERAPEUTIC MONITORING

The Data Base

Conventionally, the clinician monitors the dose response relationship of a therapeutic agent ie. the clinical response to a standard dose. However, there are a few situations in which the concentration- response relationship may be a better parameter to monitor. This process of prospectively following drug levels and deliberately adjusting the dose to achieve a therapeutic but not toxic level, is called therapeutic drug monitoring (TDM) or target concentration strategy.

The Rationale Behind Therapeutic Monitoring

The concentration response relationship of a therapeutic agent is more reliable than the dose response relationship because of the following factors:

1. Variance in patient compliance.

2. Inter patient variation in dose response relationship.

   This is due to pharmacokinetic parameters including bioavailability, distribution, biotransformation and clearance of the drug.

The concentration response relationship also shows variability between patients mainly because of pharmacodynamic variability, especially the amount of unbound drug (When we measure drug concentrations we measure the total drug levels) which determines the therapeutic or toxic effects of the drug. But the concentration response relationship is more predictable than dose response relationship because the large pharmacokinetic variability between patients which come into play when we measure dose response realtionships are largely "compensated". This is particularly important in therapeutic agents with a narrow therapeutic index.

Another area where TDM is particularly useful is in assessing the compliance of a patient to a drug.

It must be emphasized that the diagnosis of drug toxicity should not be made by measuring drug levels. It should be made on the basis of a history of ingestion, the clinical manifestations, and other laboratory data like the ECG. However in certain situations drug levels may be used to correlate the findings, guide therapy and as prognosticators of the outcome.

Which Drugs Require Therapeutic Monitoring ?

Most drugs do not require TDM. TDM is worthwhile only if the therapeutic agent satisfies the following conditions.

1. Direct and simple objective effects for measuring the efficacy of the drug are not available.

2. There is a large interpatient variability in the pharmacokinetics of the drug.

3. There is a significant clinical toxicity and the therapeutic index is narrow.

4. A clear and reversible effect between the concentration of the drug and its response is present.

5. An accurate, sensitive and specific assay with a good turn around time is easily available.

6. Data on the pharmacokinetic variables and therapeutic and toxic ranges is available.

Obtain the sample for a drug level

1. After the drug has reached a steady state in the body.

2. After four to five half lives. (2-3 half lives in a drug whose half life is shorter than the dosing interval)

3. From the contralateral arm of an IV infusion.

4. Just before the next intermittent (IV, IM, or oral) dose.

Exceptions to these include determining peak and trough levels (aminoglycosides and theophylline); at fixed intervals (methotrexate 24, 48 and 72 hours); before reaching steady state (to establish identity and severity of drug overdosage and abuse).

Drugs In Which TDM May Be Useful

Range im mcg/ml and half life in hours unless otherwise specified.

Drug	Therapeutic Levels	Usual Half Life
Antiselzure agents		
Carbamazepine	4-10	2
Clonazepam	5-70 ng/ml	23
Ethosuximide	40-100	45
Phenobarbital	10 -25	99
Phenytoin	10 -20	6 - 24
Primadone	5 -10	8
Valproic acid	50 - 100	14
Antimicrobials		
Amikacin		
Peak	20 -30	2.3
Trough	1-8	
Gentamicin		
Peak	5 -10	2-3
Trough	0.5 -2.5	
Vancomycin		
Peak	20 -40	5.6
Trough	5 -10	
Antiarrythmics		
Digoxin	0.9 - 2.0 ng/ml	39
Disopyramide	2-5	6
Lidocaine	1.5 -5.0	1.8
Procainamide	4 -10	3
Quinidine	2-6	6.2
Others		
Acetaminophen	300	2
Lithium	0.6 -1.2 mEq/ L	22
Salicyclates	150 -300	
Theophylline	10 -20	9

Table adapted and modified from Medical Clinics of North America Vol71 No.4

Errors In TDM

1. Sampling errors: These include not noting the time of taking the level in relation to the previous or next dose; drawing levels before a steady state is achieved; drawing sample from arm in which the IV/ infusion is administered.

2. Metabolites: Non measurement of active metabolites and measurement of inactive metabolites may confuse the picture.

3. Concentration: The total drug concentration (Cp) is usually measured while the active component is only the unbound drug (Cu). When the relationship between Cp and Cu is abnormal as in renal failure and hypoalbuminemia, Cp may be misleading (ie. in these situations TDM may not be useful).

4. Laboratory errors: The physician usually has no control over these.

Office kits for measurement of drugs are increasingly available. It must be emphasized that the most important requisite to TDM is a good understanding of the dynamic and kinetic properties of the drug by the physician and their sound application ***and not*** *the availability of a cheap monitoring facility (which often than not may be fallacious).*

GRAM 'S STAIN TECHNIQUE

Preparation

- Using a sterile swab or loop make a thin smear of material on a clean glass slide.
- Air dry.
- Heat fix by passing slide over flame two or three times.
- Place a wax mark near the smear.

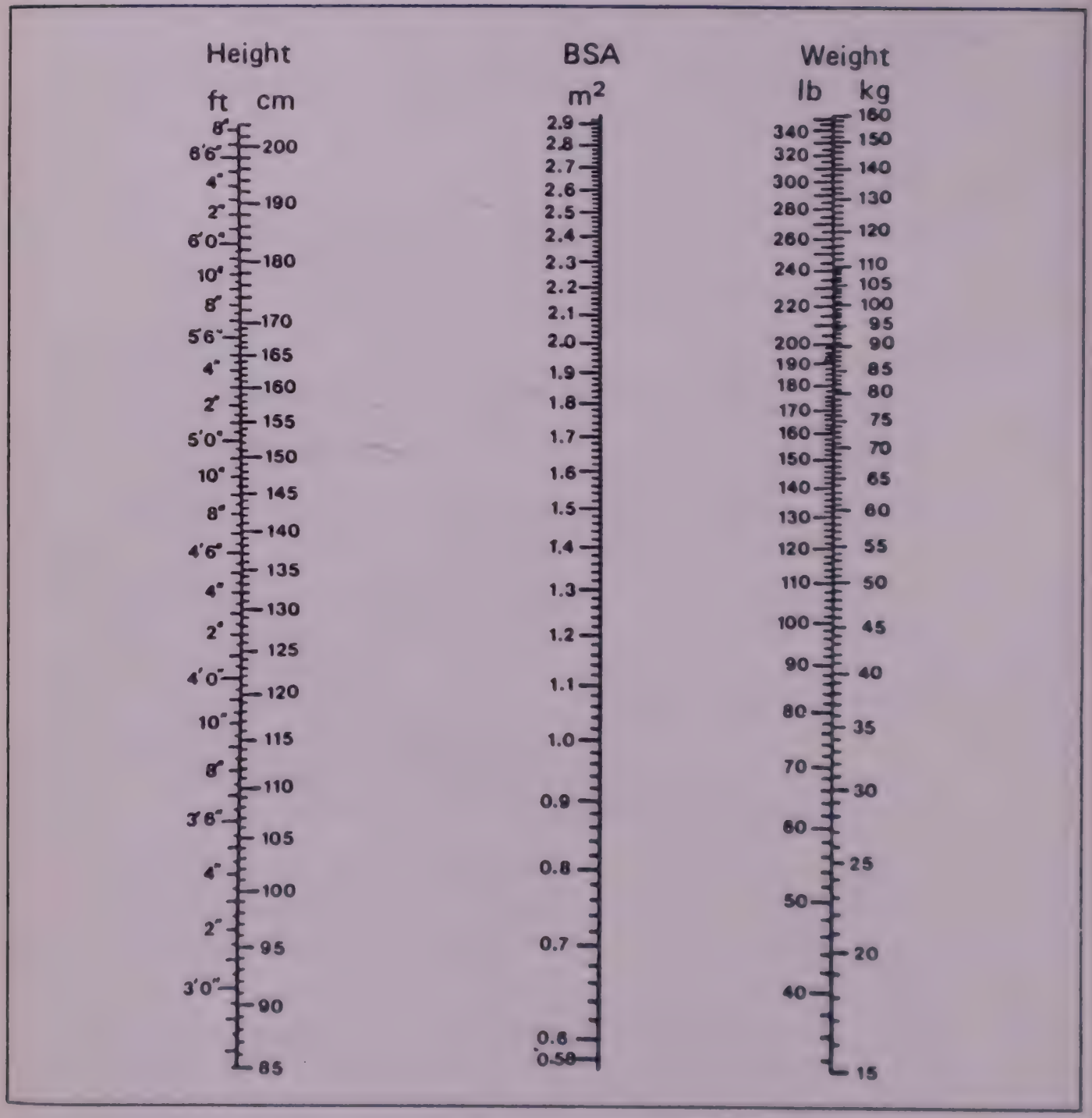
Staining

- Flood slide with crystal violet for 10 seconds. Rinse with water.
- Flood slide with Gram's iodine for 10 seconds. Flood with water.
- Decolourize with ethanol-acetone or 95% ethnol till the thinnest parts of the smear are colourless. Rinse with water.
- Flood with safranin for 10 seconds . Wash with water. Air or blot dry.

Guidelines for interpretation.

- Evaluate adequacy of specimen under low power magnification. Properly collected specimens should contain large number of polymorphonuclear leukocytes and a few epithelial cells.
- Evaluate adequacy of stain under oil immersion. If the stain has been properly carried out polymorphonuclear leukocytes will appear red; If they are blue, there has been inadequate decolourzation.
- Evaluate the presence of bacteria. Gram negative organisms appear dark blue to purple, and Gram negative organisms appear pink to red.
- Examine several areas of a smear before drawing conclusions; consider obtaining another specimen or repeating the procedure if the results are equivocal.

Nomogram For Calculating Body Surface Area In Adults.



DuBois nomogram for calculating the body surface area of adults. To find body surface of a patient, locate height in inches (or centimeters) on scale I and weight in pounds (or kilograms) on scale III and place the straight edge (ruler) between these two points. This will intersect scale II at patient's surface area. (From E.J. DuBois. *Basal Metabolism in Health and Disease.* Philadelphia: Lea and Febiger, 1936. Copyright 1920 by W.M. Boothby and R.B. Sandiford).

NORMAL LABORATORY VALUES

Note : These laboratory values conform to those found in standard international texts. However readers are advised to check up with their laboratory for its standards, especially with regards to endocrine parameters, bleeding and clotting time.

Legend : S - serum, P - plasma, B - blood.

Bleeding time

Ivy method 1-7 minutes,

Template method 3-9 minutes.

Red cell indices

Diameter 5.5-8.8 mcm

Mean corpuscular volume (MCV): Men: 80-94 fL; Women: 81-99 fL.

Mean corpuscular hemoglobin (MCH): 27-32pg.

Mean corpuscular hemoglobin concentration (MCHC): 32-36 g/dL red cells.

Color, saturation and volume indices: 1 (0.9-1.1).

Clot retraction: Begins in 1-3 hours; complete in 6-24 hours.

Fragility of red cells: Begins at 0.45-0.38% NaCl; complete at 0.36-0.3% NaCl.

Hematocrit (PCV): Men: 40-52%; Women: 37-47%.

Hemoglobin: Men: 14-18 g/dL; Women: 12-16 g/dL.

Partial thromboplastin time: Activated 25-37 seconds.

Platelets: 150,000-400,000/mcL.

Prothrombin [P]: 2 seconds deviation from control.

Red blood count (RBC): Men: 4.5-6.2 million/mcL; Women: 4-5.5 million/mcL.

Reticulocytes: 0.2-2% of red cells.

Sedimentotion rate: 20 mm/h (Westergren); 0-10 mm/h (Wintrobe).

White blood count(WBC) and differential: 5000-11,000/mcL.

Lymphocytes 20-40% (1500 - 4000)

Polymorphs 40-60% (2000 - 7200)

Monocytes 4-8% (200 -900)

Eosinophils 1-3% (0 - 700)

Basophils 0-1% (0 - 150)

BLOOD, PLASMA, OR SERUM CHEMICAL CONSTITUENTS

Aspartate aminotransferase (AST, SGOT):6-25 IU/L.

Alanine aminotransferase (ALT, SGPT): 3-26 Iu/L.

Amylase: 80-180 Somogyi units/dL.

Acetone and acetoacetate: 0.3-2/dL.

α-Amino acid nitrogen: Fasting 3-5.5 mg/dL.

Ammonie: [B] 80-110 mcg/dL (Ammonium oxalate should not be used as anticoagulant).

α1-Antitrypsin:[S] 180 mg/dL.

Ascorbic acid: [P] 0.4-1.5 mg/dL.

Acid phosphatase: [S] 1-5 King armstrong units (KA).

Alkaline phosphatose:[S] Adults: 5-13 KA units.

Base, total serum: 145-160 meq/L (145-160 mmol/L).

Bicarbonate: [S] 24-28 meq/L (24-28 mmol/L).

Bilirubin: [S] Total 0.2-1.2 mg/dL, Direct (conjugated) 0.1-0.4 mg/dL, Indirect 0.2-0.7 mg/dL.

Calcium: [S] 8.5-10.3 mg/dL. Values vary with albumin concentration.

B-Carotene: [S] fasting 50-300 mcg/dL.

Ceruloplasmin: [S] 25-43 mg/dL.

Chloride: [S or P] 96-106 meq/L (96-106 mmol/L).

Cholesterol: [S or P] 150-265 mg/dL (3.9-6.85 mmol/L).

CO2 content: [S orP] 24-29 meq/L (24-29 mmol/L).

Complement: [S] C3 90-150 mg/dL, C4 10-60 mg/dL, Total 75-160 mg/dL.

Copper: [S or P] 100-200 mcg/dL.

Cortisol: [P] 5-25 mcg/dL (138-690 nmol/L).

Creatine kinase (CK): [S] 10-50 IU/L at 30 degrees Celsius.

Creatinine: [Sor P] 0.7-1.5mg/dL (60-130 mcmol/L).

Cyanocobalamin: [S] 200 pg/mL (148 pmol/L).

Epinephrine: [P] Supine, d pg/mL (& Pmol/L).

Ferritin: [S] Adult women 20-120 ng/mL, men 30-300 ng/mL, child 7-140 ng/mL.

Folic acid: [S] 2-20 ng/mL

Glucose: [S or P] 65-110 mg/dL (3.6-6.1 mmol/L). [B]

Haptoglobin: [S] 40-170 mg of hemoglobin binding capacity.

Iron: [S] 50-175 mcg/dL.

Iron binding capacity: [S] Total 250-410 mcg/dL, Percent saturation 20-55%.

Lactate: [B] Venous 4-16 mg/dL.

Lactate dehydrogenase (LDH): [S] 55-140 IU/L at 30 degree C. 100-225 IU/L at 37 degrees C.

Lipase:[S] û units/L.

Lipid fractions [S or P] Desirable levels:

HDL cholestrerol: > 40 mg/dL

LDL cholesterol: <130 mg/dL

Magnesium: [S or P] 1.8-3 mg/dL

Norepinephrine: [P] Supine pg/L.

Osmolality: [S] 280-296 mosm/kg water) 280-296 mmol/kg water).

Oxygen: Arterial; pO2 80-100 mm of Hg (10.67-13.33 kPa at sea level).

pCO2:: Arterial; 35-45 mm Hg.(4.7-6 kPa).

pH (reaction): 7.35-7.45

Phospholipid: [S] 145-200 mg/dL (1.5-2 g/L).

Phosphorus Inorganic: [S] fasting 3-4.5 mg/dL.

Potassium: [S or P] 3.5-5 meq/L (3.5-5 mmol/L).

Protein:

Total. [S] 6-8 g/dL

Albumin [S] 3.5-5.5 g/dL

Globulin [S] 2-3.6 g/dL

Fibrinogen [P] 0.2-0.6 g/dL.

Prothrombin time: By control.

Pyruvate: [B] 0.6-1 mg/dL.

Serotonin: [B] 5-20 mcg/dL.

Sodium: [S or P] 136-145 meq/L (136-145 mmol/L).

Specific gravity: [B] 1.056 varies with hemoglobin and protein concentration. [S] 1.0254- 1.0288 (varies with protein concentration).

Sulphate: [S or P] as sulphur 0.5-1.5 mg/dL.

Transferrin: [S] 200-400 mg/dL.

Triglycerides: [S] Ñ mg/dL.

Urea nitrogen: [S or P] 8-25 mg/dL. Do not use oxalates as anticoagulant.

Uric acid: [S or P] Men: 3-9 mg/dL, Women: 2.5-7.5 mg/dL.

Vitamin A: [S] 15-60 mcg/dL.

Vitamin B12: [S] 200 pcg/mL.

Vitamin D: [S] 1,25 Dihydroxy cholecalciferol 26-65 pcg/mL.

Volume of blood: Adults: 2990-6980 mL, Women: 46.3-85.5 mL/kg, Men: 66.2-97.7 mL/kg.

Zinc: [S] 50-150 mcg/dL.

NORMAL CEREBROSPINAL FLUID VALUES

Appearance: Clear and colorless.

Cells: Adults: 0-5 mononuclear cells/mcL, Infants: 0-20 mononuclear cells/mcL.

Glucose: 50-85 mg/dL (2/3rd of serum glucose).

Pressure (reclining): New borns: 30-90 mm water, Children: 50-100 mm water,Adults: 70-200 mm water.

Proteins: Total 20-45 mg/dL, IgG 2-6 mg/dL.

Specific gravity: 1.003-1.008.

RENAL FUNCTION TESTS

p-Aminohippurate (PAH) ***clearance***: Men: 560-830 mL/min, Women: 490-700 mL/min.

Creatinine clearance: Same as inulin clearance.

Filtration fraction: Men: 17-21%, Women: 17-23% (FF=GFR/RPF).

Inulin clearance (GFR): Men: 110-150 mL/min, Women: 105-132 mL/min.

Maximal glucose reabsorptive capacity (TmG): Men: 300-450 mg/min, Women: 250-350 mg/min.

Maximal PAH excretory capacity (TmPAH): 80-90 mg/min.

Osmolality: Range 500-850 mosm/kg water, Dilution 40-80 mosm, Concentration upto 1400 mosm.

Specific gravity of urine: 1.003-1.030.

ECG Normal Intervals

P-R 0.12 - 0.2 sec.

QRS 0.06 - 0.1 sec.

QT in secs	heart rate /min
0.33 - 0.43	60
0.31 - 0.41	70
0.29 - 0.38	80
0.28 - 0.36	90
0.27 - 0.35	100

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